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BIOLOGY AND HUMAN LIFE[1]

THERE have been various definitions of biology ranging "from grave to gay, from lively to severe." It has been contemptuously called the study of life with the life left out; the science of dead animals and plants. A professor of Latin once said, "Biology deals with things as dead as the dead languages and not nearly as well preserved." One botanist who resented the forays of the bad zoologists into his preserve defined biology as "botany taught by a zoologist"; and a Scotchman has assured us that "biology is a by-word," thereby suggesting that it is the science of imprecations. But much more severe things are said and thought of biology by those who resent its encroachments into the realm of human life and spiritual values; to these biology is the Judas among the sciences: all the sciences may have forsaken their Lord, but biology has betrayed him.

Biology, or the science which deals with the phenomena of life in general, as contrasted with botany, zoology, physiology and other subjects which deal with various subdivisions of this topic, was brought to this country by Huxley in 1876 and since that time it has grown apace until it is represented in almost every college and university in the land. For a while it was resented by strict botanists or zoologists; still longer agricultural and medical sciences refused to come into the biological fold, but the necessity of a classification that would set off the sciences that deal with living things from those that deal with the not-living has gradually brought it to pass that biology and the biological sciences have taken in all subjects and disciplines which deal with life. And now in turn biologists find that their science is taken in root and branch by an all-consuming chemistry. But until chemistry is able to deal more effectively with such vital phenomena as reproduction and life-cycles, adaptation and evolution, sensitivity and behavior, there is no reason for the biologist to feel that his occupation is gone. Lovatt Evans, in his notable address a few weeks ago before the physiological section of the British Association for the Advancement of Science, said: "Physiology is something more than biochemistry and biophysics; it is and will always remain a biological subject." To which I may add my conviction that certainly biology is something more than

[1] An address delivered at Wesleyan University, Middletown, Conn., on the occasion of the dedication of the Shanklin Biological Laboratory, October 12, 1928.

physics or chemistry; it is and will always remain an autonomous science, of course using physics and chemistry and other sciences as tools, but dealing essentially with phenomena that are confined entirely to living things and are beyond the reach of the inorganic sciences.

Many humanists now feel that biologists are making the same mistake that we charge against over-exuberant chemists and physicists, and in certain instances I am bound to admit that this is true. There are distinctively human properties that are now and perhaps will always be beyond the reach of biology. The ultimate connections between body and mind, the eternal contrast between subject and object, the ego and the world, the whole realm of intellectual, moral and esthetic values, can not be explained, except verbally, in terms of protoplasm, differentiation and evolution. The recently proposed doctrine of "emergent evolution" or the older and more inclusive conception of "creative synthesis" recognizes and names the process by which new qualities appear through new combinations of constituents but it offers no explanation of this remarkable fact. The sound and sane biologist will not attempt to glorify his science by having it, like Pharaoh's lean kine, eat up all the others. While insisting upon the principle of the unity of life in all its myriad forms he will recognize that there are things connected with life, and especially with human life, which his science touches only remotely or not at all and he will cheerfully grant to anthropology, psychology and sociology the rights of independent sciences.

Having thus, as I hope, allayed suspicion and established a reputation for open-mindedness, let me take up in order some of the relations of biology to human life. In the older and narrower conceptions of biology it dealt only with subhuman forms of life. Many of these earlier biologists more or less recognized, though they did not fully realize, that it also took in human life. Only gradually have we come to see that it is fundamental to all phases of human life and that its laws or principles apply not only to the structure and function of the body but also to the development of mind and the organization of society. We will consider briefly the contributions of biology to the improvement of man's environment, then its conclusions as to the nature of man himself and finally its relations to society, ethics, esthetics and religion.

I. The Biological Environment of Man

You will not expect me on this occasion to attempt to catalogue the contributions of biology to the improvement of human environment, but its importance in this respect may be suggested by merely naming in alphabetical order some of the applied biological sciences, such as agriculture, animal and plant breeding, bacteriology, eugenics, forestry, horticulture, hygiene, medicine, parasitology, sanitation.

(1) Practically all that we eat or wear are products of plant or animal life; innumerable things used in modern life, such as oil, coal, wood, paper, leather, rubber, many chemicals and drugs, are derived from animals and plants. A knowledge of the principles of heredity and development has led to wonderful improvements in domestic animals and cultivated plants, but we have scarcely begun to realize what may yet be done in this line. In one human generation as much may be now accomplished in the improvement of useful breeds as was accomplished in the whole period of recorded history. Also much has been done in preventing or diminishing the depredations of injurious animals and plants, but there is still enormous waste from this cause that could be prevented. It has been said that the total losses from such pests is greater than all the revenues of all the governments of the world. Biology is helping to solve this agricultural problem and its solution would probably benefit agriculture more than any political remedy.

(2) The parasitic diseases of animals and men can be controlled only through a knowledge of the life-histories of the parasites. Pasteur's discovery of the causes of fermentation and putrifaction made possible his further discoveries of the causes of pebrine, anthrax and rabies and the establishment of the germinal causes of these diseases, and this in turn has made possible all the wonderful advances in modern medicine and surgery. The director of a great institute for cancer research said recently that students of that problem had reached an *impasse* and were now waiting for the biologists to suggest a solution.

(3) Researches in biology must continue to lead the way in the further progress of medicine and sanitation, in the quicker and more complete repair of bodily injuries, in the prolongation of life and the amelioration of the struggle for existence, in the solution of the population problem, which Huxley called the real riddle of the Sphinx, to which no political Oedipus had ever found the answer, in the production of better breeds of men. Biology can furnish the only real solution of these problems upon which the continuance of civilization and even the survival of the human race may depend. There were civilizations and races in the past that went down under the onslaughts of pestilence, famine and race degeneration as well as wars, and if our civilization is to survive and progress it must rely upon biology to find methods of averting these dangers.

(4) Biological researches on the races of men is even more important than those on any other organism. No other country in the world has so great a need nor so large an opportunity for such studies as has this one. This land of liberty has been the refuge of all races and types and conditions of mankind. As a people we have proceeded upon the assumption that all these refugees could be Americanized and transformed into good citizens by favorable environment and education, that Ishmaels could be converted into Israels, and both of these into Uncle Samuels, but the facts of biology do not warrant such a belief. Environment and education are not so potent as has been supposed, and heredity is not so impotent. Proper methods of dealing with immigration and with criminals and dependent persons are in part at least biological problems.

We do not know much about the effects of hybridization on human breeds; some breeds of animals and plants are greatly injured, others are greatly improved by hybridization with other breeds; we must learn more about the biological and social effects of hybridization upon the various stocks in our population. In the future eugenics, marriage selection and birth control will be ever-present and all-important subjects. Bateson, the English naturalist, has said, "The exact determination of the laws of heredity will probably work more changes in man's outlook on the world, and in his power over nature than any other advance in natural knowledge that can be clearly foreseen."

(5) Biology is destined to play a larger part in education than it has in the past. It is a curious commentary on the conservatism of educators that the science which deals most directly with life has frequently been regarded as of less importance to human beings than physics, chemistry or astronomy. Man also is a living creature and the laws and principles of biology apply to him no less than to the humblest animal or plant.

What is education but an attempt to direct development into useful paths and away from injurious ones? Instruction, tuition, advice are only stimuli or inhibitions to the developing personality and hence are parts of the environment. Information is only an incident in the process of education, the real essence of education is habit formation. The best thing that we teachers can do for our pupils, perhaps the only thing we can do, is to help them to form good habits and to avoid bad ones. Habit formation, and development in response to stimuli, are biological topics and biology is in a position to throw a flood of light on problems of education.

It is not only in the aims and methods of education but in its subject-matter as well that biology is of peculiar value. The time has come when one can scarcely be a good citizen without some knowledge of biology. The person who does not believe in vaccination or disease germs, who fights against taxes to improve the water supply or to dispose of sewage in a sanitary way or to get rid of malarial mosquitoes, who opposes the scientific inspection of milk or other foods, or the medical examination of school children is not only ignorant but he is even a dangerous citizen. It is an amazing fact that many apparently intelligent persons know nothing about the fundamental principles and processes of life in health or disease. Thousands of persons, some of them graduates of colleges and universities, seem to think that bacteria, protoplasm, chromosomes are wholly imaginary things, like fairies or demons, and that one may believe in them or not as he chooses. When leaders of public opinion are so ignorant of elementary truths which concern them so deeply, what can we expect of those who are led? Is it any wonder that all sorts of quacks, divine healers and Indian medicine men flourish, and that people generally have no conception of the biological aspects of health and disease, of reproduction and development, of eugenics and education, of the relation between bodily disease and mental and moral disorders? Think of the unutterable stupidity of a system of education which attempts to hide from young men and women the essential facts concerning sex and reproduction, heredity and eugenics! There is need for some knowledge of biology in practically every phase of modern life—family, city, state and nation—and yet this knowledge is generally lacking.

It is a fair question whether the time has not come when some knowledge of biology should be made a prerequisite not merely to the study of medicine but also to the study of the humanities in general. One of the greatest contributions of science to intellectual emancipation is the doctrine of evolution, that great theory which has revolutionized all our thinking regarding man and nature. And evolution is the distinctive contribution of biology, for it was in the living world and especially in the human realm that the establishment of evolution came as the great emancipator from tradition and superstition. The leading theme of evolution is not the origin of species, nor even the origin of living things, but rather the oneness of all life, that through all the endless diversity of the living world there run fundamental similarity and unity. We also are living beings and in the lower organisms we see ourselves in simpler and more primitive form; we see man from the standpoint of the whole living world, as superior beings in another planet might look upon us. As a result of this intellectual revolution practically all of the sciences which deal with man have become compara-

tive sciences. We can not understand man or his institutions unless we know something about his evolutionary backgrounds. This is true not only of the purely biological sciences but also of psychology, sociology and to a less extent of history, economics and the humanities in general. The past evolution of man makes plain many present tendencies in physical, intellectual and social evolution and to a certain extent it indicates the paths of future progress. Can any student of man and his institutions afford to ignore the biological foundations of human life and evolution?

II. Biology and the Nature of Man

Biological revelations concerning the nature of man have brought about what is probably the most far-reaching intellectual revolution in the whole history of the human race. Perhaps the only other similar revolution that can be compared with it is that due to the acceptance of the Copernican theory in astronomy. As the old Ptolemaic system placed the earth at the center of the universe and made all the heavenly bodies subservient to it, so the old conception of man placed him at the center and for him all other things were created. The earth was the center of the celestial sphere; the sun, moon and stars were created to give light to man, and all living things were created to minister to his needs. But just as the old geocentric conception of the solar system was replaced by the heliocentric, so the old anthropocentric theory has been replaced by the biocentric.

This change of center has necessarily brought about a tremendous change in our point of view and in our conceptions of man himself. He was once regarded as a being wholly apart from the rest of nature; the human species is now seen to be only one out of a million or more species of animals and plants. If we place in the sharpest possible contrast the old and the new conceptions as to the nature of man, as extremists are always inclined to do, we have a sad and sorry picture. According to the old view he was made in the image of God, according to the new in the image of beasts; once he was said to be a little lower than the angels, now a little higher than the apes; once he was an absolutely free moral agent, now he is never absolutely free and is often a mere automaton. It is little wonder that the fundamentalists are up in arms against this biological fall of man which is so much greater than the biblical fall. All sciences have united to dethrone man from the central and supernatural position he was once supposed to occupy, but biology is the chief regicide.

What way of escape is there? Only one so far as I can see, namely a *via media*. Both the old and the new views contain a part of the truth, but neither is the whole truth. Man is an animal, a vertebrate, a mammal, but he is also much more than any animal. He still bears in his body the marks of his lowly origin, but in the complete development of his mental and moral qualities he is in a world apart. After all evolution does not so much degrade men as it dignifies other living things. The evolutionist no less than the creationist can say with Shakespeare: "What a piece of work is a man! how noble in reason! how infinite in faculty! in form and moving how express and admirable! in action how like an angel! in apprehension how like a god!" Or with the Psalmist he can say in both humility and exaltation: "What is man that thou art mindful of him, or the son of man that thou visitest him?—Surely thou hast made him a little lower than the angels and hast crowned him with glory and honor." Evolution does not debase man by proving his animal ancestry any more than embryology degrades him by showing that he comes from egg and embryo. "The significant fact in human history is not what man begins with—for as a developing being he must begin with the lowest—but what he ends with."

Many persons who have been compelled to grant that man's body is derived from animal ancestors, have tried to maintain that his mind is a supernatural creation. Alfred Russell Wallace was one of these, but the study of the psychic processes of higher animals shows conclusively that the same sort of relation exists between the mind of man and that of animals as between their bodies. Indeed the mind is not an entity separate and distinct from the body. For convenience and effectiveness of treatment we distinguish between structures and functions, body and mind, but the organism is one and undivided. Human life can be considered from its physical, intellectual or social aspects, and in the narrower use of the term biology is limited to the first of these, and yet the principles that apply to the physical are fundamentally the same as in the case of the intellectual and social. For example, the great principle of development from the relatively simple to the complex by increasing specialization and coordination is as true of the mental and social development as of the purely physical. Heredity and environment are the factors in the development of body, mind and morals. Adaptation, coordination, regulation are essentially similar processes in all of these. Even teleology or purpose is as plainly shown in the organs of the body as in mind or society. This threefold division of human life represents only three aspects of one thing; and as we generally think in pictures or models and represent the unseen by that which is seen, so the study of mind and morals is greatly facilitated by understanding the physiological processes of the body.

To understand properly complex phenomena they must be analyzed and studied in detail. There are three principal methods of biological analysis, namely, (1) Comparison of different organisms to note what is essential and what is accidental, (2) experiment in which one factor after another is modified or omitted, (3) development from the simple to the complex. These three methods of analysis may be applied to the structures and functions of the body or to the organization of the mind and of society. When Romanes was writing his books on "Mental Evolution in Animals and Man" Darwin wrote him, "I am delighted to hear that you mean to work the comparative psychology well—Frank says you ought to keep an idiot, a deaf-mute, a monkey and a baby in your house."[2] I once heard former President Patton of Princeton University describe with inimitable humor this new kind of psychology based upon the study of idiots, deaf-mutes, monkeys and babies, and yet this method of Darwin is the method of biological analysis by means of comparison (the monkey), nature's experiment (idiot, deaf-mute) and development (the baby), and the results of such studies have led to a new era in psychology.

As we see in lower forms of life the same principles and processes as those that occur in human life, but in simpler and more elementary form, so we can often analyze and interpret these more complex phenomena by means of the simpler ones. Thus comparative psychology has thrown a flood of light upon human psychology. And the study of animal societies, the instincts of the herd, the spirit of the hive, is helping us to understand the origin and nature of human society. Paraphrasing the well-known sentence of Terence, "Nothing that concerns man is foreign to me," the biologist may say, "Nothing that concerns life is foreign to man."

Ever since the doctrine of human evolution was fairly launched there have been scientists who have seemed to take delight in shocking more conservative persons by affirming that man is only an animal and a pretty poor specimen at that. They are ready to explain all the higher human faculties as the results of tropisms, and these as mere mechanical responses due to chemistry and physics. Life itself is said to be only a condition of activated atoms and all the thinking and feeling and doing of men is at bottom only a dance of these atoms. A distinguished physiologist once recited to me in a sort of frenzy his creed of unbelief: "There is no God, no devil, no heaven, no hell, no soul, no immortality, no freedom, no responsibility," and at another time in a more reflective mood he added the inevitable conclusion to such a creed: "The evolution of consciousness was the greatest blunder in the universe." If perforce we must reach such conclusions, we must. It has been well said that "Truth is truth even if it sears our eyeballs," but we should be sure that it is inevitable before we permit it to blind us. That such conclusions are not inevitable is shown by the number of first-class scientists who reject them. It is a curious fact that biologists are often more extreme mechanists than the physicists, whereas physicists more frequently hold that life is something more than chemistry or physics. When a science is relatively new it is, I think, invariably true that scientists underestimate the problems they attack and overestimate the importance of their work. But the more these problems are studied the more profound they are found to be. How crude do most of the older theories of biology now seem! The carbon theory of life, the phosphorus theory of mind, the artificial production of life, the tropism theory of all animal behavior! How crude are the popular ideas of the capacities of "the mechanical watchman," or the "robots"! It is refreshing, therefore, to hear the distinguished physiologist, Lovatt Evans, saying in his address at the British Association: "Science can not fathom the mystery of life." The period of frenzied physiology is giving place to a more reflective, more rational and more humble attitude. And if science is unable to fathom the mystery of life in its simplest forms, how much less is it able to explain in terms of physics and chemistry the mysteries of human life: of memory, reason, volition, of responsibility, purpose, aspiration, altruism! How little can it fathom the deeps of the nature of man!

III. Relations of Biology to Society, Ethics and Religion

(1) The old-fashioned natural history from which modern biology has descended made no such direct connection with human life as do the biological sciences to-day. At most the resemblances between man and animals were analogies rather than homologies. Perhaps the first human applications of the lessons of natural history were in the field of morals and religion. The busy ant and bee, birds that in their nests agree, dogs that delight to bark and bite, and multitudes of other more or less fabulous moral or immoral qualities of animals were examples to be followed or shunned. The study of natural history does not seem to modern biologists to afford such shining examples of moral or immoral qualities among animals as the moralists of a former period and the "nature-fakirs" of the present day assume. According to students of animal behavior, the busy ant is busy because she likes to be busy; aphids feed ants

[2] "More Letters of Charles Darwin," vol. 2, p. 49.

because they as well as the ants get pleasure from it; the mother bird or mammal feeds and cares for her young because of the pleasure it gives her. A similar view regarding human ethics is being advocated. One author says it is more blessed to give than to receive because motions of the hands away from the body are more pleasant, for some unknown reason, than those toward the body.

We need not deny that pleasure and pain enter into our conceptions of ethics, but it is often, and in the higher sense always, the pleasure or pain or welfare of others rather than that of self that is the basis of ethics. Any one who has seen a mother bird or a mother mammal defend her young even to the point of her own fright, injury or death will realize that she is not doing it for her own pleasure. Is human ethics based on any lower level than this?

(2) Somewhat akin to the moral aims in the study of natural history was that of esthetic appreciation of the beauties, the perfection, the joys and sorrows of living creatures. Some of the best work that has ever been done in this field has been by lovers of nature, of flowers and insects and birds and even of microscopic organisms. Busy men and women have made such studies their hobby and have incidentally produced work of the greatest value. Indeed it may be questioned whether such naturalists as Hooke, Leeuwenhoek, Swammerdam, Ehrenberg, Trembley, Sprengel, Gilbert White, Hudson and Gosse, Lord Avebury, Erasmus and Charles Darwin, Fabre, Gregor Mendel and a host of other amateurs (using this term in the sporting sense to indicate merely those who lived *for* but not *by* their sport) have not contributed more to our knowledge of living things than have all the professionals. All these amateurs studied biology because of their love of it, for the esthetic and intellectual pleasure which it gave rather than for any material or professional gains. Indeed they usually pursued such studies at great sacrifice of money and effort and often even of reputation, and it may be doubted whether any great work has ever been done in any other spirit. No other science makes so direct and telling appeal to esthetic appreciation and broad sympathies as biology, and it ill becomes narrow professionals of this age to despise the old naturalists and their work.

The late Professor Blackie, professor of Greek in Edinburgh University, once said that every young person ought to study natural history and music because of the pleasant occupation, interest and solace they would afford in periods of stress and sorrow. But biologists should remember that he also said in tolerable verse:

> Give me no peeping scientist if I
> Would view God's grandly ordered world aright.
> But give to plant my cosmic survey high,
> The wisest of wise Greeks, the Stagirite.

And another Greek, Euripides, said in immortal verse:

> Blessed is he who has gained knowledge of nature,
> Who seeks neither the woes of citizenship
> Nor rushes into unjust deeds,
> But who observes the ageless order of immortal nature,
> How it is constituted and when and why!
> To such the practice of base deeds never cleaves.
>
> (Fragmenta 910, Nauck)

(3) To many of our predecessors, natural history was the handmaid of religion, demonstrating the wonders and goodness and purpose of God in the living world. In reading the older works on natural history one is impressed by the fact that they were written by devout men, frequently by Christian ministers, for devout purposes. Among the most notable of such works are the famous "Bridgewater Treatises," whose primary aim was the demonstration of intelligent design in the living world. Again modern biologists do not find such plain demonstrations of divine beneficence and of supernatural design in the living world as former naturalists did. But the evidences of an ultimate teleology in all living things is more abundant and compelling than ever before. In biology we can not if we would get away from the idea of purpose, disguise it as we may by such words as "significance," "meaning" or "benefit." In practically every structure and function of living things we see ends to be reached and we can not avoid the conclusion that life is a process of ends as well as of means. Professor L. J. Henderson in two deeply philosophical books has extended such teleology from the organism to its environment and even to the entire order and system of nature. And Lovatt Evans, to whose recent address I have already referred, says: "Mechanistic interpretations tend in the long run to become arrogant and superficial, as vitalistic ones predispose to scientific nihilism. For while it is inconceivable that living things do not obey the laws of nature, yet it is equally unthinkable that a chance encounter of physico-chemical phenomena can be the explanation of their existence." Certainly from the standpoint of life the biologist is warranted in assuming that this is a world of teleology as well as of mechanism.

And so far as the wonders and mysteries of life are concerned they never grow less with increasing knowledge but rather more. Every mystery solved in part only leads to more profound mysteries, world without

end. When frenzied physiologists or chemists announce the solution of all mysteries of life and mind and soul in the motions of atoms or electrons I have sometimes proclaimed myself an "apostle of mystery" —not in the sense of the mystic who cherishes mystery and resists attempts at a scientific explanation of such phenomena, but rather in the spirit of one who recognizes that nature is infinite and that our science explores only the shores of the great ocean of truth.

In these days devout scientists do not generally proclaim their devoutness as they did a generation ago. Probably few if any modern laboratories exhibit the motto which Agassiz placed on the wall of his laboratory at Penikese: "The laboratory is to me a sanctuary. I would have nothing done in it unworthy of the Great Author." But in reverence for and devotion to truth, in admiration of the order and beauty and mystery of nature, modern laboratories are no less sanctuaries than those of any preceding age.

I often think of the fine faith of the founders of most of our colleges and universities—faith that the development of science and learning would serve only to confirm their religious creeds—and I wonder what they would think if they could revisit these institutions to-day. No doubt many of them would be shocked if they could know of the tremendous changes which science has wrought in those creeds. But for all those who seek truth above all things there is no cause for alarm. Truth is greater than creed or dogma, and the motto of science is the saying of Christ: "Ye shall know the truth and the truth shall make you free."

In closing I wish to congratulate the students and staff of the department of biology, and the trustees, the faculty, the alumni and friends of Wesleyan University upon the completion and endowment of the new Shanklin Biological Laboratory. May it through all the years to come be a center of teaching and research; may it contribute to the material welfare of men; most of all may it be a source of intellectual enlightenment and spiritual freedom, thus demonstrating the intimate relation between biology and human life!

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EXPEDITION OF U. S. COAST GUARD CUTTER MARION TO THE REGION OF DAVIS STRAIT IN 1928

THE Coast Guard cutter *Marion* returned to New London, Conn., September 28, 1928, after having spent ten weeks at sea investigating the physical character of the water masses between North America and Greenland, from St. Johns, Newfoundland, northward to the 70th parallel of latitude off Disko Island, Greenland.

The main object of the expedition was to learn the whole story regarding the wanderings of the icebergs from the time they break off the Greenland ice cap until they finally melt 1,800 miles southward in the warm waters of the North Atlantic. The direction and velocity of the ocean currents have been mapped by the *Marion* expedition according to the so-called Bjerknes' methods of dynamic hydrography. The fundamental values necessary for substitution in Bjerknes' formulae are those of temperature and salinity of water from frequent depths, surface to bottom, and similar data from such stations scattered net-like over the ocean area as it is desired to include. The resulting maps show the contour in dynamic meters of the chosen decibar surface relative to that of a deep decibar plane, which is the one usually employed as a bench mark. For practical purposes the contour lines connecting equal dynamic values will be stream lines of the water current in a similar fashion as the direction of the wind tends to parallel the direction of the isobars on an ordinary weather map.

Here is a case where physical oceanography is employed to solve an economic problem of practical importance. Icebergs form a distinct menace as evidenced by the *Titanic* disaster of 1912. The U. S. Coast Guard is the bureau under our government which has been charged with the responsibility of maintaining a patrol of the ice regions every spring for the protection of transatlantic shipping. Although the United States actually carries out the work, our country is, nevertheless, reimbursed by about fourteen maritime nations, thus giving this humanitarian work a true international character.

The International Ice Patrol ships (two Coast Guard cutters) have since 1921 been carrying out a systematic program of scientific investigation mostly centered on physical oceanography. The field of observation has been confined to the waters around the Grand Banks, especially where the Labrador current discharges its freight of ice into the easterly moving masses of the Gulf Stream. In the summer of 1914 the Coast Guard attempted to send a research vessel, the *Seneca*, northward of Newfoundland, but unusually bad ice conditions that year caused the cruise to be abandoned. It has remained until this summer for the Coast Guard to undertake a major exploration northward into the region between Greenland and North America—practically unknown waters. The *Marion's* survey, therefore, covering the ocean from the iceberg-producing glaciers to the Grand Banks constructs an uninterrupted story of the life history of the iceberg.

The *Marion* cruised a total of 8,100 miles, or the distance from New York to Sydney, Australia, from July 7 to September 18. The vessel was stopped at 191 stations where over 2,000 serial sub-surface observations were made with the oceanographic instruments. A fathometer, for recording the depths by means of submarine echo, took over 2,500 measurements, thus developing a detailed bathymetrical map of a region where formerly areas of 50,000 square miles contained not a sounding.

The *Marion* expedition marks a departure from former oceanographic voyages in that 2,000 odd samples of sea-water taken from the depths were tested for salinity immediately on board instead of conducting such tests months afterwards in a laboratory on shore. The salinity-testing machine measures the dissolved chemical salts in the water in grams per thousand by means of the electrical conductivity of the water itself.

For those unfamiliar with the waters investigated, it may be said that the *Marion* expedition covered a region as extensive as that from Cape Cod to Key West and having a mean width off shore of 500 miles. The amount of physical data collected exceeds that of any recent oceanographic work with the exception of the three-year German *Meteor* expedition in the South Atlantic. In fact, the frequency of stations and the location of the observation points at right angles to general trend of the circulation are the main features of the *Marion's* work.

Although it is early as yet to state definite and final results, there are certain outstanding features which are of much interest.

(a) A surface layer of water 100 meters thick, covering most of the oceanic basin between Labrador and Greenland, was found to be about five degrees Centigrade warmer than normal. This represents an additional heat reservoir of tremendous proportions and one that is bound to have far-reaching climatic effects. The presence of this mass lends support to the assertion of many that the Arctic climate has undergone recent temporary amelioration.

(b) The bottom water found in the trough between Greenland and North America had a temperature of 2.6° C. and a salinity of 34.90. The observations show that this water was not produced on the surface, either as a result of winter cooling as suggested by Nansen, or by melting ice as claimed by Pettersson. The observations indicate, on the contrary, that the bottom water even in this extreme northwestern corner of the North Atlantic has its source as a slow creep from the Antarctic.

(c) The depth survey reveals the west Greenland half as much narrower and its slope a smuch steeper than shown on the present-day maps. The Labrador shelf is reliefed by a depression about forty miles out which extends as a trough along the entire coastal length.

(d) Three headlands in southern Baffin Land were accurately located by the *Marion*, showing discrepancies between present charts of as much as 20 miles.

(e) Arctic waters were unusually open this summer. There were about a thousand icebergs counted in Disko Bay near the glaciers; about two hundred bergs on the Labrador coast near Cape Harrison, but other places than these were featured by a remarkable absence of icebergs. The Arctic pack during August was shrunk to an outer edge thirty miles off Cape Dier, Baffin Land, and no field extended south of Cumberland Sound. Cape Farewell was sighted on September 1 but here there was not a piece of ice in the famous East Greenland current.

The scientific report of the *Marion* expedition will be published some time within the next year by the U. S. Coast Guard as one of its series of Ice Patrol Bulletins.

EDWARD H. SMITH,
Lieutenant-Commander U. S. Coast Guard
Commander Marion Expedition

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

GRANTS FOR RESEARCH IN 1929

THE American Association Grants are not unfamiliar to most of its members. Yet, if, each year, the opportunities and conditions relative to these grants are brought to the attention of investigators needing aid in their respective fields, experience indicates that a good end is being served.

The sum available each year is derived from the income from endowment and varies somewhat. Last year it was $3,000 and it is reasonable to expect that a sum approximating this will be available next January. Out of this, allotments are to be made to individuals who make application before December 1. The amounts are necessarily small. They have rarely exceeded $500 and usually they have been considerably smaller. It is expected that the work contemplated, which may be partly finished or about to be begun, would not be possible without financial aid such as this. Grants are usually for apparatus, for assistance or for necessary travel; they are seldom for publication.

Applications for grants should be addressed to the permanent secretary of the association, at the Washington office. From him may be obtained special

blank forms for this purpose and they should be used. The latest date for the receipt of an application is December 1. Two supporting letters are needed, from persons acquainted with the applicant and with his project. It is suggested that those desiring to become applicants for grants for work in 1929 should secure blanks very soon, filling them out and returning them promptly and arranging for the supporting letters to reach Washington before December 1.

The applications for 1928 aggregated more than $18,000. This necessitated, of course, the disappointment of a large proportion of those who had applied. On the other hand, the sum total of actual allotments for 1927 was somewhat less than the amount available. There is no reason for hesitation in sending in or in renewing an application.

Attention is directed to the rule whereby unsuccessful applications are not carried forward for reconsideration in a subsequent year. Any one is free to apply again but his application must be renewed in full.

Applications received at the permanent secretary's Washington office are referred to the Committee on Grants for Research, whose final action is to be taken at the New York meeting. Results will be announced in January, the funds becoming then immediately available. A grant may be disbursed in a single sum or in installments, according to the wishes of the grantee. Any money undisbursed by the end of the fiscal year (September 30) reverts to the treasury unless the grantee specifically requests that an undisbursed balance of his grant be carried forward to the next fiscal year. Requests of this nature are also referred to the Committee on Grants for approval.

Progress reports on work still uncompleted are expected and they should be in the hands of the permanent secretary before December 1 following the award of the grant. When a project is completed a final report should be sent in. Blanks for reports may be obtained from the permanent secretary's office.

The membership of the Committee on Grants for Research for 1928 is as follows. The number in parenthesis shows the calendar year at the end of which the member's term of office expires.

Walter S. Adams (1931) (for astronomy), Mt. Wilson Observatory, Pasadena, California; Karl F. Kellerman (1931) (for botany), Bureau of Plant Industry, Washington, D. C.; W. Lash Miller (1930) (for chemistry), 8 Hawthorne Ave., Toronto, Ont., Canada; Oswald Veblen (1930) (for mathematics), Princeton University, Princeton, N. J.; L. G. Hoxton (1929) *Chairman* (for physics), University of Virginia, University, Va.; Vernon Kellogg (1929) (for zoology), National Research Council, Washington, D. C.; Joseph Erlanger (1928) (for physiology), Washington University School of Medicine, St. Louis, Mo.; Nevin M. Fenneman (1928) (for geology), University of Cincinnati, Cincinnati, Ohio.

Applicants should feel free to make inquiries of any member of the committee and suggestions or recommendations from without its membership relative to applications that come before it are welcomed by the committee.

General and detailed information about these grants may be found in the last volume of the *Summarized Proceedings* of the American Association for the Advancement of Science and in two articles in SCIENCE for October 7, 1927 (pp. 319–320) and for November 18, 1927 (pp. 491–492). Applications for grants and requests for blanks on which applications are to be made should be addressed to Burton E. Livingston, permanent secretary, Smithsonian Institution Building, Washington, D. C.

L. G. HOXTON,
Chairman of the Committee on Grants
UNIVERSITY OF VIRGINIA

THE SECRETARIES' CONFERENCE

THE Secretaries' Conference is a special committee of the American Association, organized at the Nashville meeting. It aims to furnish facilities for the section and society secretaries to become better acquainted with one another and with the affairs of the association, and for exchange of thought on questions of mutual interest. Its membership consists of the secretaries of the affiliated societies, the secretaries of the association sections, the general officers of the association and the members of the executive committee of the council. The conference aims to bridge a gap between the section organizations and the affiliated societies, on the one hand, and the legislative and executive organization of the association, on the other hand. The secretary of the conference corresponds throughout the year with its members on topics of importance and mutual interest, summarizes the results of this correspondence and prepares a program for the annual session of the conference at the annual meeting of the association. He is chairman of that session, at the opening of which the next secretary is elected.

Both by correspondence and by free discussion at the annual session, suggestions are considered for improvement in the relations between the affiliated societies and the association and recommendations may be made to the council from the conference. General aims as well as details of routine procedure may be taken up in a preliminary way by this special committee in a much more satisfactory manner than

is possible at the council sessions, which are necessarily short and very crowded with legislative business. The annual sessions of the secretaries have already proved to be very valuable in aiding the association officers to cooperate more satisfactorily with the affiliated societies. They were instituted at the Toronto meeting, in December, 1921, and have met with the approval of the affiliated society and section secretaries. They have become an important part of the annual meeting and it is hoped that the definite and continuous organization of the Secretaries' Conference will be of still further advantage to the association and all its affiliated societies.

The New York session of the conference is to be held on the evening of Sunday, December 30, probably at the Lincoln Hotel, Eighth Avenue at 44th Street. A complimentary dinner will be provided by the association, preceded by opportunity for general informal renewal of acquaintance and followed by the session. Those to be invited to this dinner and session are: (1) the secretaries of the affiliated societies that meet with the association at New York, (2) the secretaries of the association sections, (3) the executive committee members and other executive officers of the association and (4) a few special guests whose presence may contribute to the success of the session. Invitations are to be sent out from the permanent secretary's office about December 1. Those who receive invitations are asked to assemble at the room reserved for this purpose as soon as possible after the close of the symphony concert on Sunday afternoon. The dinner is planned for 6:30, but it is hoped that every one will come early.

The letters sent out during the year by the secretary of the Secretaries' Conference have met with such a generous response that a very interesting session is assured. The questions and topics proposed for discussion have been grouped and summarized and the results have been reported to the members. Some of these topics have been placed on a program or order of business for the session and leaders have been asked to open the discussion in each instance. In some cases they will present information and the results of special studies on the questions involved. There will be opportunity for free discussion in the session and it is hoped that all present will take part. Time will probably be available for brief discussion of other topics than those shown on the program.

The program will include the election of a secretary of the conference for 1929, a general introductory statement of the nature and aims of the conference and the discussion of the following topics.

(1) *Meeting and programs.* Relation of the association and the affiliated societies in the preparation and conduct of programs; procedure when affiliated societies meet with section and when they meet elsewhere or at other times. Preparation of programs to avoid conflicts and to bring together scientists in different but related fields. Problem of adhering to schedule in scientific sessions, of encouraging free access from one session to another held at the same time. Messenger service for the biological group.

(2) *Membership.* The work of the secretaries of affiliated societies and of the association's Washington office in maintaining and increasing membership. Getting new members, billing members, handling of members in arrears, dropping from roll members not in good standing.

(3) *Standards of presentation.* Can the general standard of the presentation of papers at our meetings be raised; would it be desirable for the association to attempt to arrange for the preparation and publication of a pamphlet on the presentation of scientific material?

(4) *Exhibitions.* Value of the exhibition feature of the annual meeting and the problem of securing scientific exhibits. General exhibition and special exhibits of technical societies, their relation and availability to the public.

(5) *Is it desirable to consider the possible reorganization* of the association, to have fewer sections, fewer officers, fewer vice-presidential addresses and a simpler organization? Three sections have been suggested, with the societies or other groups acting as sub-sections. The three fields suggested are: the exact and physical sciences (present sections A, B, C, D, E, M); the biological sciences (present sections F, G, H, I, N, O), and the social sciences (present sections K, L, Q).

(6) *Additional topics if time permits.*

GEORGE T. HARGITT,
Secretary, Secretaries' Conference

SCIENTIFIC EVENTS

THE GEORGE HERBERT JONES CHEMICAL LABORATORY OF THE UNIVERSITY OF CHICAGO

THE laying of the cornerstone of the George Herbert Jones Laboratory was accompanied by an informal ceremony participated in by the donor, Mr. George Herbert Jones, Acting President Frederic Woodward, Professor Julius Stieglitz, Trustee Harrison B. Barnard, Mr. David Evans and others. The secretary of the board read a list of the contents of the cornerstone box, which included copies of Mr. Jones's letters of gift; photographs of the donor, of the four presidents of the university, of the two presidents of the board of trustees and of Professors

Stieglitz, Harkins, Schlesinger, Glattfeld, Rising and other members of the staff, besides the customary official documents.

A committee from the department of chemistry, of which Dr. Julius Stieglitz was chairman, recommended the choice of subjects for the carved figures of the building, and these are being put into position as the construction goes forward. *The University Record* says:

There are three niches, each large enough to hold one figure. For these three figures we have selected the following men: Lavoisier, the great French chemist of the end of the eighteenth century, who is considered the founder of chemistry as a science; Wohler, the great German chemist, who was professor of chemistry at Göttingen University and might be considered the founder of the science of chemistry of life, and, third, the great Russian chemist, Mendeléeff, whose periodic law for the chemical elements was enunciated about 1869.

For the head on the outside of the first floor of the west side of the building, Dalton was chosen, the great English chemist, who is considered the founder of the modern atomic theory.

At the entrance of the building a head of Willard Gibbs was selected; and on the other side, a head of August Kekulé. Gibbs was an American and the founder of modern physical chemistry. Kekulé, a German, is the founder of modern organic chemistry.

Other symbols include the Bessemer converter, indicating the fundamental connection between chemistry and industry; the medical caduceus to indicate the connection between chemistry and medicine or life; a balance, of the shape and type used by Lavoisier; a retort, a common symbol of the science of chemistry itself; a pair of crystals of optical opposite faces, which commemorate the great work of Pasteur, and a spectroscope, commemorating the fundamental work of Bunsen with the physicist Kirchhof. If the spectroscope should not lend itself to this use, the symbol of a hexagon, an important milestone in the development of organic chemistry by Kekulé, will be substituted.

HIGHWAY ENGINEERING

LEADING highway officials of all parts of the world are coming to the United States in 1930 to study the methods of road improvement and the use of roads in this country, according to a statement made by Thomas H. MacDonald, chief of the Bureau of Public Roads, who recently returned from a meeting of the International Road Commission held in Paris. Mr. MacDonald went to France as head of the official delegation representing the government of the United States. After the meeting he investigated highway development in the British Isles and countries of western continental Europe. Mr. MacDonald says:

Not only was the invitation extended by our congress through President Coolidge accepted unanimously, but from comments of delegates from other countries it is evident there is a deep-rooted, world-wide interest in what is being done to improve highways here.

The great distinction which exists between our program and that of other nations is that, while here the whole country has adopted motor transportation, elsewhere car use is still largely in the hands of a few.

The rapid expansion in the United States faced our engineers with an urgent demand for the immediate improvement of hundreds of thousands of miles of highway. At the same time, increased valuations growing out of bettered transportation facilities and a moderate tax upon the vehicle itself made it actually cheaper for the public to have roads than to go without them, so we were able to embark upon a construction program without parallel in the history of public works without dislocating our financial system.

Concurrently we were faced with the question of whether it was cheaper to build these roads slowly and laboriously by human labor, as most other countries now do, or whether we should work out mass production methods and so meet the national demand quickly. Experience has demonstrated that the latter plan is by far the more efficient and less costly.

Foreign highway engineers, who are as well versed as our own men in the technique of road building, or are better versed, are, in the main, only now arriving at the stage where they must meet similar problems in their own countries; hence their interest in the sessions here in 1930.

Further, because of the wide diversity of geographical, climatic and soil conditions in the United States, coupled with varying degrees of wealth and population, it is possible to approximate here the basic problems which confront engineers from abroad, whether they are interested in congested areas, such as England has, in primary roads, such as are needed in the newer countries, or in questions of mountain roads, such as those faced by Austria, Switzerland and other nations.

So the United States in 1930 will be a giant laboratory in highway development and motor transportation where highway officials from other countries will find an opportunity to see not only what has been accomplished from an engineering point of view, but also to observe the social and economic influences of our good roads.

At the same time our engineers will have an opportunity to learn what is being done in other countries and to compare notes with their foreign colleagues.

THE AMERICAN STANDARDS ASSOCIATION

UNANIMOUS approval by the thirty-seven member bodies of the establishment of the American Standards Association to succeed the American Engineering Standards Committee is announced by William J. Serrill, assistant general manager of the United Gas Improvement Company of Philadelphia, who was chairman of the Standards Committee, and now becomes president of the American Standards Association.

One of the first acts of the association will be the organization of a board of directors composed of twelve industrial executives. This newly created board, which was established in recognition of the increasing part which executives are playing in the standardization movement, will control the general administration and policies of the association. The old main committee, made up of representatives of all the member-bodies, now becomes The Standards Council, and in its hands will rest all matters connected with the adoption and approval of national standards.

The officers of the association are, in addition to Mr. Serrill: *Vice-president,* Cloyd Chapman; *secretary,* P. G. Agnew, and *assistant secretary,* F. J. Schlink. The advisory committee of industrial executives includes: J. A. Farrell, president of the U. S. Steel Corporation, *chairman;* George B. Cortelyou, president of the Consolidated Gas Company; John W. Lieb, senior vice-president of the New York Edison Company; L. F. Loree, president of the Delaware and Hudson Company, and Gerard Swope, president of the General Electric Company.

The American Engineering Standards Committee was organized in 1917 by the American Society of Civil Engineers, the American Institute of Mining Engineers, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, and the American Society of Testing Materials. The purpose of the organization was to provide a method of cooperation which would prevent duplication in standardization work and the promulgation of conflicting standards. The United States Government Departments of War, Navy and Commerce became members of the committee in 1919. New members were from time to time added until at the time of the present reorganization there were 37 member-bodies. There are in addition 350 sustaining members, including manufacturers, distributors, associations, etc.

THE ASSOCIATION OF CONSULTING CHEMISTS AND CHEMICAL ENGINEERS

A group of the leading professional consultants representative of all branches of chemistry and chemical engineering met recently at the Chemists' Club in New York to perfect the organization of the Association of Consulting Chemists and Chemical Engineers.

Dr. Alexander O. Gettler emphasized the importance to the public of the following points in the Code of Ethics:

> Every individual on entering the Association of Consulting Chemists and Chemical Engineers, and thereby becoming entitled to full professional membership, incurs an obligation to advance the science and art of chemistry and chemical engineering, to guard and uphold its high standard of honor, and to conform to the principles of professional conduct. He shall refrain from associating with or allowing the use of his name by any enterprise of questionable character. If, in his opinion, work requested of him by clients seems to present improbability of successful results, he shall so advise before undertaking the work. He shall be conservative in all estimates, reports, testimony, etc., and especially so if these are in connection with the promotion of a business enterprise. He shall be diligent in exposing and opposing such errors and frauds as his special knowledge enables him to recognize.

As stated by Dr. Louis P. Hammett in discussing the report of the committee on constitution, the objects of the organization are:

> By all proper means to advance the science and practice of consulting chemistry and chemical engineering; to further the service of the profession to its clients, to the public, and to all branches of the government; and to promote friendly intercourse and cooperation among its members so that their welfare be furthered, and the highest ethical standards of the profession be maintained.

Others who spoke were: Dr. D. P. Morgan, Jr., Dr. Alvin C. Purdy, Louis O. Bergh, Russell Raynor, Irving C. Bull, Henry E. Cutts, Ludwig Saarbach, Joseph Geisler, Harry P. Trevithick, Clarence P. Harris, George H. Walden, Jr., and Emil Schlichting.

Following this general discussion the constitution and by-laws were unanimously adopted.

The following officers were elected: *President,* Hal T. Beans, of Columbia University; *vice-president,* Irving Hochstadter, of Hochstadter Laboratories; *secretary,* Clarence V. Ekroth, of Ekroth Laboratories, and *treasurer,* Jerome Alexander. The following were elected directors: Charles V. Bacon, Frank C. Gephart, Robert Schwarz, of the Schwarz Laboratories; Albert M. Smoot, of Ledoux and Co.; Albert G. Stillwell, of the Stillwell Laboratories; Arthur W. Thomas, of Columbia University, John Morris Weiss, of Weiss and Downs, and Thomas A. Wright, of Lucius Pitkin.

BIBLIOTHECA MATHEMATICA

In December, 1920, in a communication to Professor D. E. Smith, the late Dr. Gustav Enestrom expressed the hope that the publication of the *Bibliotheca Mathematica* might be continued in the United States, it having been discontinued in Europe in 1915. Prompted by this request, the Mathematical Association of America made a serious effort to raise a subsidy fund for this purpose, but was unsuccessful. Now, however, it is hoped to carry out this project on a largely self-supporting subscription basis, and the association has sent out a communication which says:

In order to determine the feasibility of such an undertaking, the trustees of the association appointed a committee consisting of R. C. Archibald, W. D. Cairns, Florian Cajori, H. E. Slaught and D. E. Smith, with power to make such investigation as might seem best. This committee sent a communication to some fifty persons in Europe, Asia and America, asking for an expression of opinion and for permission to use their names as members of an advisory committee. The responses were almost unanimously in favor of the project and in many cases helpful suggestions and proffers of assistance were freely given.

The committee of the association is, therefore, encouraged to proceed a step further, having the friendly cooperation of so large a number of representative persons on three continents. The publication, if undertaken by the association, will, as before, be international in character and will aim to maintain a high standard in its editorial management.

What we need to know is how many subscribers to the new series of *Bibliotheca Mathematica* can be counted upon. It is proposed to keep the general subscription price at five dollars, the same as was formerly charged, notwithstanding the cost of publication has more than doubled since the last volume appeared in 1914, and notwithstanding the number of pages per volume will be maintained and possibly increased. But the association proposes to make a special subscription price, as in the case of all its publications, to its individual and institutional members. The price proposed for the *Bibliotheca Mathematica* to members of the Mathematical Association of America will be four dollars per volume. This can be done only on the basis of a large list of subscribers and through the partial aid of certain subsidy funds.

Subscriptions should be sent to the Secretary of the Mathematical Association of America, Professor W. D. Cairns, Oberlin, Ohio, U. S. A., to whom all communications should be sent.

SCIENTIFIC NOTES AND NEWS

As has already been noted in SCIENCE, the autumn meeting of the National Academy of Sciences will be held in Schenectady, New York, from November 19 to 21. Public addresses will be given by Dr. Harlow Shapley, director of the Harvard College Observatory, on "The Center of the Universe," and by Dr. Irving Langmuir, of the General Electric Company, on "Oil Films on Water."

A MEETING in memory of Edgar Fahs Smith, former provost and Blanchard professor of chemistry in the University of Pennsylvania, will be held on December 4 at four o'clock in the Irvine Auditorium of the university. Addresses will be made by Dr. Francis X. Dercum (class of '87 medical), president of the American Philosophical Society; Dr. Marston Taylor Bogert, professor of organic chemistry in Columbia University, and Dr. Josiah H. Penniman, provost of the university.

DR. HARVEY NATHANIEL DAVIS, formerly professor of mechanical engineering at Harvard University, will be installed as president of the Stevens Institute of Technology at Hoboken, N. J., on November 23. Dr. Davis and President Lowell will make addresses at the inauguration ceremonies. At a scientific session to be held in the morning the principal speakers will be Dr. John Johnston, director of research of the U. S. Steel Corporation, and Dr. Robert A. Millikan, of the California Institute of Technology.

THE Thomas Burr Osborne gold medal of the American Association of Cereal Chemists, established in 1926 and named in honor of Dr. Thomas B. Osborne, of the Connecticut Agricultural Experiment Station, "as a commemoration of his notable services to cereal chemistry," was presented for the first time at the annual convention of that association, the recipient being the person for whom the medal is named. It is intended that this medal shall be awarded only for unusually meritorious contributions to cereal chemistry. In connection with the presentation, C. B. Morison, of the American Institute of Baking, gave a review of Dr. Osborne's forty years of sustained research in biochemistry, more especially in the field of plant proteins. The medal was presented by President Leslie R. Olsen. As Dr. Osborne was unable to attend the convention it was received on his behalf by Dr. Carl L. Alsberg, of Stanford University.

THE Morris Liebmann memorial prize, which was awarded recently to Dr. Walter G. Cady, head of the department of physics at Wesleyan University, was presented to him at a meeting of the Institute of Radio Engineers in New York City on November 7, by Dr. Alfred N. Goldsmith, president of the society. The medal was given for Dr. Cady's "fundamental investigation in piezo-electric phenomena and their application to radio technique." This award is made each year to that member of the institute who in the opinion of the board of directors has made the most important contribution to the radio art.

DR. JOHN W. LIEB, senior vice-president of the New York Edison Company, received the decoration of Officer of the Legion of Honor on November 2, at a meeting of engineers in New York City. The presentation was made by G. Girousse, president of the Société Nord Lumière, on behalf of the French government, "in recognition of services in furthering professional and industrial cooperation between

French and American engineers and in facilitating the interchange of knowledge and experience regarding the construction and operation of central station systems."

The Chandler lecture will be given this year by Mr. John Arthur Wilson, chief chemist of A. F. Gallun and Sons Company. His subject will be "Chemistry and Leather." Friends of Professor Chandler presented in 1910 to the trustees of Columbia University a sum of money which constitutes the Charles Frederick Chandler Foundation. The income from the fund is used to provide a lecture by an eminent chemist with a medal to be presented to the lecturer in further recognition of his achievements in science. Previous lecturers on this foundation were: Leo H. Baekeland, W. F. Hillebrand, W. R. Whitney, F. Gowland Hopkins, Edgar F. Smith, Robert E. Swain, E. C. Kendall, S. W. Parr and Moses Gomberg.

The gold medal for outstanding contributions to the technical development of the paper industry has been awarded by the Technical Association of the American Paper and Pulp Industry to William H. Mason, of Laurel, Mississippi, for his process of making insulating board and artificial lumber, and to Ogden Minton, of Greenwich, Connecticut, for his vaccum dryer.

Dr. H. B. McDonnell, chemist in animal pathology at the Maryland Agricultural Experiment Station, was elected president of the Association of Official Agricultural Chemists at the annual meeting held in Washington on October 29, 30 and 31. He succeeds Dr. Oswald Schreiner, chief of the division of soil fertility of the Bureau of Chemistry and Soils, who presided at the meeting.

Dr. Charles P. Emerson, professor of medicine and dean of the medical faculty of the University of Indiana, was elected president of the newly established American Foundation for Mental Hygiene at the annual meeting of the National Committee for Mental Hygiene held in New York City on November 8. It is proposed to raise $1,000,000 for the support of the foundation, of which amount the sum of $150,000 has already been subscribed. Plans for the first international congress on mental hygiene, to be held at Washington in May, 1930, were also adopted.

Sir Humphry Rolleston has accepted the position of honorary president of the British Industrial Health Education Society, a body which had its origin in Scotland, but which has now for some time been established in London. The society promotes its objects largely by the provision of health talks and the promotion of free discussion among industrial workers, the only questions which may not be raised at its meetings being those that relate to disputes between employers and employed.

Under the auspices of the Rockefeller Foundation three research and teaching fellowships of the value of £500 a year will be established in the medical school of the University of Dublin. The first fellowship began on October 1, last, when Dr. R. A. Q. O'Meara was nominated as Rockefeller Foundation Fellow in Public Health. The two remaining fellowships will be established in October, 1929, and October, 1931, respectively.

Dr. Chas. H. Herty, industrial consultant with special reference to the natural resources of the southern states, announces the opening of offices in New York City. He will continue his connection with the Chemical Foundation as special representative.

Dr. Samuel T. Orton has announced the opening of an office in New York City for the practice of neuropsychiatry, with special attention to the reading disability and speech defects of children. Dr. Orton was for nine years professor of psychiatry and director of the State Psychopathic Hospital of the State University of Iowa. He is this year president of the American Psychiatric Association.

Dr. J. Austen Bancroft has resigned his position as professor of geology at McGill University. His present mailing address is in care of the Anglo-American Corporation of South Africa, Ltd., Broken Hill, Northern Rhodesia, South Africa.

Official delegates to the International Conference on Civil Aeronautics, to be held in Washington on December 12, 13 and 14, have been appointed by President Coolidge as follows: Secretary of Commerce Whiting, *chairman;* Senator Bingham, of Connecticut; Nelson T. Johnson, Assistant Secretary of State; F. Trubee Davison, Assistant Secretary of War; W. Irving Glover, Assistant Postmaster-general; Edward F. Warner, Assistant Secretary of the Navy; William F. MacCracken, Assistant Secretary of Commerce; Colonel Charles A. Lindbergh, Orville Wright, Harry Guggenheim, of New York; Lester D. Gardner, of New York, editor of aviation publications, and Professor Joseph S. Ames, of the Johns Hopkins University, a member of the National Advisory Board of Aeronautics.

An investigation of airplane vibration, particularly with reference to its effect on airplane instruments, is to be made by a special research committee of the American Society of Mechanical Engineers as the result of a conference held recently at society headquarters under the auspices of the aeronautic division.

Those attending the conference were Dr. W. F. Durand, Stanford University; J. Leopold, Consolidated Instrument Company; E. Campbell, Cambridge Scientific Instrument Company; Thomas Carroll and H. E. Reid, both of the National Advisory Committee for Aeronautics; Captain E. E. Aldrin, Standard Oil Company, chairman of the aeronautic division, and Professor Alexander Klemin, Daniel Guggenheim School of Aeronautics, New York University, *secretary* of the division. The program as tentatively outlined includes (1) the collection, from all possible sources of information as to vibration difficulties at present encountered with airplane instruments, and as to causes for such difficulties; (2) the collection of all experimental data on instrument vibration now available; (3) the preparation of a report on the information collected, and the circulation of such conclusions, as might be of service, to instrument manufacturers and airplane designers, and (4) the outlining of further investigations which might subsequently be undertaken by some interested organization.

M. BERNARD TROUVELOT, entomologist of the Versailles Institute of Research in Agriculture and professor of horticulture, who has spent almost a year in studying entomological problems in the United States, has completed his work and is on his way back to France by way of Japan.

DR. D. N. KASHKAROV, professor of zoology, Middle Asiatic State University, Tashkent, Russia, is visiting the United States.

THE ABRAHAM FLEXNER lectureship at the Vanderbilt School of Medicine will be inaugurated by a series of five lectures on "Melistic Structure" by Dr. Heinrich Poll, director of the institute of anatomy at the University of Hamburg.

DR. F. D'HERELLE, professor of bacteriology in the school of medicine of Yale University, formerly director of the bacteriological service in Egypt, will deliver the second Harvey Society Lecture at the New York Academy of Medicine, on Saturday evening, November 24. His subject will be "The Nature of the Ultraviruses."

DR. EDWIN B. FROST, of the Yerkes Observatory of the University of Chicago, gave two lectures during October at Oberlin College, on the Mead-Swing Foundation, and spoke at a chapel service. His subjects were "The Dominion of the Sun" and "The Systems of the Stars."

DR. C. TELFORD ERICKSON, director of the Albanian-American School of Agriculture, gave a lecture at Harvard University on November 15, entitled "Cabbages and Kings."

DR. GEORGE E. UHLENBECK, of the University of Leiden, lectured before the Franklin Institute on November 15, on "The Ideal Gas in Modern Physics."

DR. R. G. GREEN, of the department of bacteriology and immunology of the University of Minnesota Medical School, gave a lecture on November 5 on "Encephalomyelitis of Carnivorous Animals," before the department of animal pathology of the Rockefeller Institute, Princeton.

DR. OSCAR RIDDLE, of the Carnegie Institution, addressed a joint meeting of the Society of Internal Medicine and the Institute of Medicine of Chicago, on the evening of October 26. The subject was "Some interrelations of sexuality, reproduction and internal secretion."

DR. VICTOR EMANUEL EMMEL, professor of anatomy in the college of medicine of the University of Illinois, died suddenly on November 8. Dr. Emmel was fifty years old.

RICHARD C. DRINKER, of Quincy, Massachusetts, consulting metallurgist, formerly of the Bethlehem Shipbuilding Corporation, died on November 5.

THE U. S. Civil Service Commission announces that applications for the position of cytologist to fill the vacancy in the hygienic laboratory at the U. S. Public Health Service, Washington, D. C., must be on file with the commission not later than November 28. The entrance salary is $3,700 a year. The duties are to conduct under general supervision research on the growth of normal and malignant cells in vitro, to study the action of light on cells, to cooperate in radiometric studies and to carry on other research.

THE annual meeting of the American Society of Mechanical Engineers will be held in New York City from December 3 to 7.

THE nineteenth annual exhibition of electrical, optical and other physical apparatus will be held by the British Physical Society and the Optical Society on January 8, 9 and 10 at the Imperial College of Science and Technology, South Kensington.

AT the Annual Conference of Biological Chemists resolutions were adopted protesting against the proposed decrease in the number of hours devoted to biochemistry in the curriculum of medical schools from 200 to 146 and proposing that the prerequisites in chemistry be more definitely prescribed and, if possible, include quantitative analysis.

THE scientific work accomplished by the *Città di Milano,* the base ship of the *Italia* expedition which returned to Spezia on October 20, as reported in the London *Times,* is the subject of an official *communiqué,* summarizing the report submitted by Com-

mander Romagna Manoia, who was in charge of the ship. Observations were made as to the effect of solar rays on magnetic disturbances which bear an intimate connection with the aurora borealis. These observations, which continued for an uninterrupted period of six weeks, were greatly facilitated by their fortunate coincidence with a phase of maximum solar activity. Successful results were obtained with a new Italian type of naval compass which had been modified for use in the Arctic regions. Experiments were also made with the gyroscopic compass, as a result of which the use of this type of instrument is now found possible, even in a latitude exceeding 80°. Further observations were made on the course of the Gulf Stream, and an astronomic mast was erected in Kings Bay which, it is claimed, will henceforth be the mathematical center for the future polar explorers.

THE *Journal* of the American Medical Association writes that the committee appointed by the British government has made an interim report endorsing the American view that ethyl gasoline may be used for automobiles. However, there is a certain amount of opinion in that country among chemists and physicians that such use of this substance is dangerous. In a letter to the *Times*, a well-known chemist, Professor H. E. Armstrong, accuses the committee of accepting American conclusions without critically sifting their sufficiency. He objects to the specious use of the term "ethyl" in such a connection, which is calculated to mislead and fails to warn. Ethyl is the technical name of C_2H_5 and should not be used in any other sense. "The Americans seem to have emphasized lead and to have thought of and tested for little else." But Professor Armstrong holds that lead tetra-ethide is not dangerous primarily as a lead poison but as a poison in itself acting as a whole, as a neutral liquid poison akin to the solvents used in varnishing fabrics, which have caused much serious poisoning. It has a special affinity for fatty tissues and is likely to pass into the nervous system and brain. Though the amount of poison to which we are exposed at present may be homeopathic, it must be remembered that makers are alive to the greater efficiency of high compression for internal combustion in the presence of anti-knock materials.

WITH increased facilities in the way of larger appropriations and new office equipment now at its disposal, the Kentucky Geological Survey, founded originally by the General Assembly in 1854, is at the present time in a position to render a greater public service than ever before. Under the direction of the state geologist, Dr. W. R. Jillson, the offices on the first floor of the old capitol building are open to all every week day as a source for all kinds of information relative to the geology, mineral resources, topography and similar subjects pertaining to Kentucky. Comprehensive indexed rock, ore and fossil collections are maintained at Lexington, Frankfort and at the State Fair at Louisville. Field surveys are now actively in progress with a total personnel of about 100 individuals. Of these, 25 per cent. are assigned to geological and mineral resource investigations while the balance upwards of 75 are engaged in topographic extensions. Nearly 100 separate topographical sheets, over 300 non-duplicating maps and about 60 bound reports are now available at nominal statutory charges.

PROFESSOR ROGER, dean of the Faculté de médecine de Paris, states in his annual report, which is summarized in the *Journal* of the American Medical Association, that the number of medical students continues to increase. The total number of such students for the last three school years was: 1924–1925, 2,510; 1925–1926, 2,515, and 1926–1927, 2,676. The number of students matriculating for the first time was: 1924–1925, Frenchmen, 533; foreigners, 203; total, 736; 1925–1926, Frenchmen, 561; foreigners, 237; total, 798; 1926–1927, Frenchmen, 607; foreigners, 295; total 902.

THE report of the Irrigation Division of the American Society of Civil Engineers on "A National Reclamation Policy" has made public the following statement of principles: The waiving of interest payments to landowners on government reclamation projects is unwise. In the future the government contributions should appear in the assumption of a part of the cost of projected works and not in the granting of relief to the individual farmer such as the waiving of interest charges. The United States Bureau of Reclamation has formulated a program of construction covering the ensuing ten years, involving expenditures of approximately $100,000,000. To the extent that commitments have been made the bureau should fulfill its assumed obligations and the landowner should be required to meet his obligations or surrender his holding in the government project. The regulation of the flow of streams for the prevention of floods and for the best possible utilization of the waters should be undertaken by the states, or jointly by the United States, and the states under such suitable forms of cooperation as may be appropriate under the constitutional authority now delegated to each. They should bear an equitable portion of the cost of water storage and flood control work, and the remainder of the cost should be allocated to flood, control, irrigation, power, development, municipal water supply and other purposes. Agricultural conditions due to overproduction are such at present that it is undesirable for the fed-

eral government, except in the case of commitments already made to bring new areas under cultivation.

UNIVERSITY AND EDUCATIONAL NOTES

HARVARD UNIVERSITY has received an anonymous gift of $3,000,000 to build and endow a residence college of the type of the colleges of the Universities of Oxford and Cambridge.

TWO bequests amounting to $700,000 contained in the will of Charles Lennig, who died thirty-seven years ago, have become available to the University of Pennsylvania at the final distribution of the estate. One bequest of $500,000 creates the "Charles Lennig Fund in Aid of Instruction in Theoretical and Practical Mechanics." Its income will be used for the acquisition of scientific works, structures, instruments, machines and material for the Towne Scientific School of the university. The other bequest of $200,000 establishes the "Charles Lennig Beneficiary Fund," the income from which will be devoted to providing free scholarships.

GROUND has been broken on the Columbia University campus for a new building to house the natural science department, which will be erected at a cost of $1,000,000. It will be situated in the southeast corner of the Grove on Amsterdam Avenue, facing 119th Street, and will be ten stories in height. Architecturally it will be almost identical with the Chandler Chemical Laboratories.

DR. ALEXANDER RUTHVEN has been appointed dean of administration with the duties of vice-president of the University of Michigan.

DR. LEON E. SMITH, of the Randal Morgan Laboratory of Physics of the University of Pennsylvania, has accepted the position of professor of physics and head of the department of physics at Denison University, Granville, Ohio.

DR. AMOS M. SHOWALTER, National Research Fellow, 1924–27, has been appointed assistant professor of botany in Washington University.

DR. HARRY HELSON, of the department of psychology of Cornell University, is now associate professor of experimental psychology in Bryn Mawr College, taking the place of Dr. Clarence E. Ferree, who is now at the Johns Hopkins University.

DR. GUY HAROLD SMITH, who was a member of the department of geography of the Ohio State University last year during the absence of Dr. Roderick Peattie, has joined the faculty of the department of geology and geography of the University of Illinois. He will have charge of the courses on weather and climate and geomorphology.

DISCUSSION AND CORRESPONDENCE

ON NUCLEAR DERIVATIVES AND THE LETHAL ACTION OF ULTRA-VIOLET LIGHT

THE bactericidal action of ultra-violet light has been known for fifty years, and has been repeatedly investigated. But few investigators have sought the mechanism of the reaction or the chemical units of the bacterial protoplasm so affected by the ultra-violet energy as to prevent the subsequent multiplication of the cells.

If measured monochromatic ultra-violet energy is used to kill bacteria such as *S. aureus,* lying in a single plane, and its effect is recorded statistically, characteristic and similar curves are produced at each wave-length studied. These curves show that an appreciable amount of energy must be incident on the bacteria before any of them succumb. With longer exposures they succumb along a gradient that is for the most part apparently exponential, but experimental evidence indicates that its course is determined by differences in the resistance of single bacteria, and that the curve is therefore one of probability. Wide differences are found in the incident energies required to produce these curves at different wave-lengths, and if the same points on each gradient (say 50 per cent. destruction) are joined by a smooth curve, its shape is such as to suggest immediately that it is reciprocally related to the absorption of ultra-violet energy by some sensitive element in the bacterial protoplasm.

In 1917 Harris and Hoyt[1] suggested that "the susceptibility of protoplasm to ultra-violet light is conditioned by the selective absorption of the toxic rays by the aromatic amino acid radicals of the proteins." Their conclusion was based on the observation that a screen or filter of an aromatic amino acid solution—tyrosine or aminobenzoic acid, for example—greatly prolonged the exposure to the quartz mercury arc necessary to kill Paramecia, and that therefore these substances must be absorbing the very wave-lengths responsible for the lethal changes in these organisms.

Such a conclusion, however, does not exclude the possibility that other biochemical entities essential to life may also show a selective absorption over the toxic range, and it may be that the lethal reaction is due to some, or some one, of these other substances.

Recently a further search has been made for the substance most probably involved. Since the nucleus

[1] F. I. Harris and H. S. Hoyt, SCIENCE, 1917, N.S. 46: 318.

is recognized as the structural element in the cell on which growth and reproduction depend, attention was naturally directed to nuclear derivatives, and it was found that the reciprocal of the bactericidal curve matches the absorption curves for certain derivatives of the nucleoproteins—cytosine, thymine and uracil—more closely than it does those for various aromatic amino acids, such as tyrosine, tryptophane or phenylalanine, suggested by Harris and Hoyt.

The close reciprocal correspondence between the curve of bactericidal action and the curves of absorption of ultra-violet energy by these nuclear derivatives not only promotes the probability that a single reaction is involved in the lethal action of ultra-violet light, but has a wider significance in pointing to these substances as essential elements in growth and reproduction. This conclusion is in harmony with the observations of other writers. Thus, Murphy, Helmer and Sturm,[2] by electrodialysis, have effected a marked concentration of the active agent in transplantable tumors of fowls. The material which, as they are careful to say, "carries" the active agent, appears to be a nucleoprotein, and gives "a uniform Feulgen reaction[3] of the so-called thymonucleic acid group."

And now Cowdry[4] has applied the Feulgen reaction to tissue cultures of normal fibroblasts and of various sarcomata, and finds that under these experimental conditions the nuclei of both rat and chicken sarcomata are much richer in the substance giving the Feulgen reaction—presumably thymonucleic acid. Cowdry also studied various neoplastic tissues obtained from mice in comparison with normal tissues similarly stained. As was to be expected, "the thymus gland always gave a more pronounced Feulgen reaction than the tumors," but in the other fragments of tissue "the nuclei of the tumor cells were more strongly stained so that the extent of the neoplasms could be readily seen by naked-eye inspection of the slides." Under the microscope, however, this difference between the nuclei of tumor cells and of normal cells could not be made out, and Cowdry does not attempt an explanation of the discrepancy between the results obtained in tissue cultures and those obtained with excised material.

Thus, while the relation of thymonucleic acid to cell growth and reproduction remains a matter of conjecture, nevertheless its high concentration in the thymus gland and the coincidence of the evidence from these three independent series of experiments seem worthy of note, without further comment at present.

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[2] J. B. Murphy, O. M. Helmer and E. Sturm, SCIENCE, 1928, N.S. 68: 18.

[3] R. Krause, *Enzyk. f. Mikr. Tech.*, 1927, 3: 1729.

[4] E. V. Cowdry, SCIENCE, 1928, N.S. 68: 138.

NOMENCLATURE OF THE ACCESSORY FOOD FACTORS

THE science of chemistry, broad in scope and voluminous in terminology, requires that the names by which substances are known shall be chemically correct and indicative of certain class relationships between compounds. To this end there has grown up the custom of indicating the chemical structure of compounds in the first part of the name applied thereto and of showing class relationships by a similarity in the ending of the name. Examples of this are too numerous and familiar to require mention here. What is true for the entire body of chemistry is correct to an equal degree for the divisions thereof and should apply likewise to related fields.

At the present time there is a cycle of confusion in the field of nutritional chemistry because of failure to apply the principles mentioned above. The fact that this failure has been, in part at least, unavoidable does not alleviate the difficulty and the rapidity with which research is moving forward makes very necessary the adoption of a more suitable system of naming the known accessory food factors, the so-called "vitamins."

Funk[1] in 1913 applied the term *vitamine* to a group of nutrient principles, then only two in number, the existence and necessity of which had been previously proven. This term, as Funk used it, meant literally substances associated with life processes and chemically closely related to the amines, inasmuch as Funk believed them to be amine-like in structure. This theory, unfortunately for present-day terminology, has not been borne out and it was long ago recognized, as pointed out by McCarrison,[2] that the name *vitamine* was a misnomer. In fact the abridgement of the term *vitamine* to *vitamin*, while in accordance with the policy of the Chemical Society (England) and conforming to the American method of naming the hormones, was a tacit admission of the incorrectness of Funk's terminology.

The proposal of McCollum and Kennedy[3] in 1916, that the two "vitamins" known at that time be desig-

[1] C. Funk, "Die Vitamine," Wiesbaden, 1913.

[2] McCarrison, Robert, "Studies in Deficiency Disease," Oxford Med. Public., 1921.

[3] E. V. McCollum and Cornelia Kennedy, "The Dietary Factors Operating in the Production of Polyneuritis," *J. Biol. Chem.*, 1916, xxiv, 491.

nated by a letter and a prefix denoting characteristic solubility, was widely adopted. With the proof of the existence of other factors of similar nature this method has been extended and the "vitamins" lettered alphabetically in the order of their discovery.

The appellation "Fat-soluble A," "Water-soluble C," etc., not only implies nothing concerning the relationship between the nutrient principle in question and the pathological condition occurring in man and animals in its absence, but is in addition too limited in its implied meaning, and while perhaps adequate for the period when only two or three accessory factors were known it has become somewhat confusing with the added designation of newly discovered factors. Moreover, with the separation of one of the original factors into two component parts certain hitherto unforeseen complications arise.

If the suggestion of Hunt[4] and others be followed, namely, that one fraction of the hitherto designated "vitamin B" be termed "vitamin F" and the second fraction "vitamin G," then "vitamin B" ceases to exist in its original sense, and there is a break in the alphabetical sequence of designation. Of more consequence than the mere disruption of the alphabetical method of naming, however, is the fact that great confusion is introduced into extant "vitamin" literature. The suggestion of Chick and Roscoe[5] that the term "vitamin B" be retained for one fraction is not only incorrect from previous standpoints, but will lead to difficulties—difficulties which will be augmented if the "vitamin B" complex is further fractionated. Moreover, the above suggestions are not universal, certain writers using different designations. Added to this is the possibility, not entirely remote, that "vitamin A" may eventually give way to H and I, that "vitamin C" may lose its existence in giving birth to K and L, etc. The resultant confusion need only be suggested.

In justice to existing terminology and the efforts of those who established it it must be said that certain difficulties peculiar to this branch of chemistry stand in the way of following the orthodox method of naming chemical entities. Chief among these obstacles is the fact that the chemical constitution of these substances, with one possible exception, is unknown. The characteristic effects accompanying the absence of "vitamins" from the diet of man and certain animals (the syndromes of the deficiency diseases) is known, however, and based upon this fact the author has evolved a system of naming which it is hoped will be of some value.

According to this plan the generally accepted term *vitamin* would be discarded and the name *advitant* substituted therefor in accordance with the recommendation of McCarrison.[6] This step is believed desirable in order to eliminate the ending *amin*, which is a meaningless hangover, while retaining the term *vita* to indicate the close association of these substances with life processes. Then, in place of an alphabetical designation of the accessory food factors, each would be designated by a prefix in accordance with the disease for which it is preventive, and the suffix *amin* would be *provisionally* retained for all until such time as the chemical structure of the substance was established. With the chemical structure known the ending *amin* could be replaced by one denoting the chemical relationship.

Accepting for the moment the recent work which indicates that "vitamin D" is irradicated ergosterol, an example will be given to show how the nomenclature herein recommended would work out. The antirachitic factor would be termed an *advitant* and provisionally designated as *rachitamin*. Granted that its identity as an activated sterol was established, the suffix *amin* would be replaced by the term *sterol*, making the permanent name *rachitasterol*.

The provisional names suggested for the vitamins now known and the relation of these names to those now in use are given below in tabular form:

TABLE I

Group name	Generally accepted name	Suggested provisional name	Possible permanent name
Advitant	Vitamin A or Fat-soluble A	Ophthalamin	
	Vitamin B or Water-soluble B	Polyneuramin Pellagramin	
	Vitamin C or Water-soluble C	Scorbutamin	
	Vitamin D	Rachitamin	Rachitasterol
	Vitamin E	Sterilamin	

While realizing the limitations of the nomenclature given above the author believes that the names suggested not only indicate the relationship between the accessory food factors and the deficiency diseases effected in their absence, but that they offer a means of stabilizing the present confusion, at the same time providing for future expansion and correction.

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[4] Charles H. Hunt, "The Complex Nature of Vitamin B as found in Wheat and Corn," *J. Biol. Chem.*, 1928, lxxviii, 83.

[5] Hariette Chick and Margaret H. Roscoe, "On the Composite Nature of the Water-soluble B vitamin," *Biochem. J.*, 1926, xxi, 698.

[6] *Loc. cit.*

BREEDING HABITS OF OCTOPUS

Octopus rugosus Bosc is the common octopus of the Florida Gulf Coast and seems to be particularly abundant on the sandy flats near the city of Fort Myers. On February 18, 1928, the writer, while exploring the shallow water along the sandy shore known as Crescent Beach, picked up a shell of the so-called pearl oyster which, upon being opened, was found to contain a small female octopus of this species, together with a batch of eggs. The position of the octopus in the shell was one in which the tentacles were thrown back over the body with suckers from each individual tentacle fastened to each valve of the shell and holding the shell tightly closed. The eggs were deposited—a clump to each half of the shell—fifty-seven eggs in one cluster and seventy in the other—each egg being attached to the shell by a gelatinous thread which proved to be a continuation of the egg capsule. The eggs were cylindrical in shape, five to six mm long, about two mm in diameter, with the attachment thread two mm in length. At this time all the eggs were cloudy at the distal end with a limited clear region at the proximal end and some of them bore also near the proximal end a black dot, which it was later determined marked the position of an eye.

On March 6, a second shell, this time a cockle shell, was found with an adult octopus and eggs inside. The eggs in this case each had two black spots near the proximal end, which spots, it was noted, were the pigmented eyes of the young octopus. On March 20 a heavy storm strewed the beach with débris, and following the storm some twenty shells with octopus eggs were collected, and in fifteen of the specimens the adult octopus was found either in or near the shell. The size of the eggs at this date had increased to a length of 9 to 10 mm and a diameter of 2.5 mm and all at this time showed young octopi within. A quantity of eggs was placed in sea water for observation, with the result that within a day's time young octopi had emerged from many of them. The process of emergence of the young octopi began when the young animals, which were at first located at the proximal end of the eggs or in the clear area already mentioned, with the body close against the attached end and with the tentacles extending out over the cloudy yolk, began to swallow the yolk. This process of engulfing the yolk continued for some hours, it being essential, apparently, that the yolk be partially swallowed before the young animal could escape from the egg capsule. When about half of the yolk had been engulfed, and after much twisting and squirming, the young octopi reversed ends by sliding past or exchanging places with the still partially unswallowed yolk substance. So far the young animal appeared to be almost transparent, very little pigment outside of that in the eyes being visible.

Within an hour or so after the reversal of ends, during which time the body of the octopus was pressed against the distal end of the egg capsule, a round cap (sometimes irregular) popped off of the distal end of the egg case, leaving a circular aperture just large enough to allow the young octopus to squeeze through to freedom. The body of the octopus usually slipped through this opening easily, but there was often some difficulty in pulling the tentacles with the unswallowed yolk through the exit. When this was at last accomplished, the evacuated, thin, translucent, collapsed egg capsule remained attached to the shell by the stalk. Once free the young octopus settled down to finish the swallowing of the yolk and at the same time began rapidly to show color. After about an hour the yolk had disappeared within, and the young octopus, now a perfect miniature of the adult, with much of the adult's ability to swim or crawl about and to change color, began an active, independent life. Under the binocular scope, rows of pigment cells looking like rows of colored blocks within the transparent protoplasm were now visible, these pigment cells appearing to lie at different levels. The rows were not mixed, however, *i.e.*, all the blocks in a given row were brown, yellow, green, etc., as the case might be.

It appears, then, that the breeding habits of the Florida octopus, *Octopus rugosus*, agree with those reported for other species in that the eggs are laid and development takes place during the winter months. For the region of Fort Myers, Florida, the eggs are probably laid early in February and after a developmental period of from five to eight weeks, during which time the eggs are brooded and aerated by the adult, the young emerge as perfect miniature octopi, there being no metamorphosis subsequent to hatching.

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LOVELAND LOESS: POST-ILLINOIAN, PRE-IOWAN IN AGE

THE following statement was made by the writer in 1924 in an abstract of a paper published in the *Bulletin* of the Geological Society of America, Volume 35, page 73:

The name "Loveland formation" was given by Shimek to a deposit in western Iowa which is a "heavy, compact, reddish (especially on exposure to the air) or sometimes yellowish silt which when dry is hard with a tendency to break into blocks like a joint clay and when wet becomes very tough and sticky and hence is sometimes called a gumbo." The type section of this formation is at Loveland, Harrison County. By early workers this formation was thought to be related to the wide-

spread buff loess of the region, but Shimek believed that it was a fluvio-glacial deposit "formed during the melting of the Kansan ice." In many places it is calcareous and contains calcium carbonate concretions, many of which are from three to six inches in diameter; a few were seen with greatest diameter more than twelve inches. The Loveland does not show the laminations of water-laid clay, but in places sands and silts of distinct aqueous origin are interstratified with the Loveland clay and in a few places volcanic ash is interbedded with the formation. Moreover, it has the vertical cleavage of loess and stands with similar vertical faces. Although in places fossil shells are present in the Loveland, they are extremely rare in comparison with the numbers of shells which are in the buff loess. The writer believes that the Loveland is not a fluvio-glacial deposit, but a loess distinctly older than the widespread buff loess which overlies the Loveland and which is thought to be chiefly of Peorian age; the Loveland is younger than the Kansas glacial epoch, since it lies upon the maturely eroded surfaces of Kansan till.

This statement was based upon investigations in a comparatively limited region near the type section, which is on the east slope of the Missouri River valley. The views to be presented in this brief paper are the result of detailed studies of the Loveland formation in widely distributed exposures in Iowa. The characteristics, distribution, origin and age of the deposits of Loveland time in Iowa have been determined and will be described fully in a paper now in preparation.

In western and northwestern Iowa, at least, the Loveland deposits consist not alone of loess, but also of widespread silts, sands and gravels. While the Loveland silts, sands and gravels were being deposited in valleys, the Loveland loess was accumulating on adjacent slopes and uplands.

With the writer's knowledge of the characteristics and relationships of the Loveland loess and associated silts, sands and gravels in western Iowa as a background, he examined similar deposits in that part of northwestern Iowa which lies west of the Des Moines lobe of the Wisconsin terminal moraine, where within the last few years Frank Leverett, J. E. Carman and the writer have found evidence of a post-Kansan, pre-Peorian drift which is apparently of the same age as the Iowan drift of northeastern Iowa. Within this Iowan drift area of northwestern Iowa the Loveland loess, silts, sands and gravels are post-Kansan gumbotil erosion, pre-Iowan in age. The Loveland deposits are younger than the valleys cut in the Kansan drift and are overlain in some places by calcareous Iowan till and in other places by unleached gravels of Iowan age.

The Loveland deposits were traced next into central and southern Iowa, then into the Iowan drift area of northeastern Iowa and finally into the Illinoian drift area of southeastern Iowa. In the Iowan and Illinoian areas only the loess phase of the Loveland deposits has been found thus far. In the Iowan drift area of northeastern Iowa this loess is post-Kansan gumbotil erosion, pre-Iowan in age. Here the Loveland loess is underlain by Kansas gumbotil or Kansan till and overlain by calcareous Iowan till. In the Illinoian area of southeastern Iowa the Loveland loess is post-Illinoian gumbotil, pre-Peorian loess in age.

This same relationship of a loess younger than the Illinoian gumbotil and older than Peorian loess was described by Leighton in a paper published in the *Journal of Geology* in 1926 on the Farm Creek section, east of Peoria, Illinois. He interpreted the older loess to be late Sangamon in age. Leverett in a personal communication expressed the opinion in 1926 that old reddish loess which he had seen in several localities "should perhaps be put in the early Sangamon." The evidence indicates that the reddish or brownish loess older than the widespread Peorian loess to which reference has been made from time to time for many years by different geologists in western and southwestern Iowa, eastern Nebraska, northwestern Missouri and western Illinois, is Loveland loess.

The Loveland loess has now been established by stratigraphic methods as being much younger than the Illinoian glacial drift and older than the Iowan glacial drift. The significance of the determination of the definite age of the Loveland loess must be emphasized. It would seem to settle conclusively the relative ages of the Illinoian glacial stage and the Iowan glacial stage. The Loveland loess was deposited after the development over wide areas, chiefly by chemical weathering, of a gumbotil more than three feet thick on the Illinoian till. Furthermore, there was sufficient time after the Loveland loess was laid down for this loess to be leached to a depth of several feet before the coming of the Iowan ice sheet.

The knowledge of the Loveland loess adds new evidence to that which has been presented for many years by several geologists in support of the view that the Iowan glacial stage is much younger than the Illinoian glacial stage. There is at present no adequate basis for correlating the Iowan drift with the Illinoian drift as was suggested recently by Leverett in "The Pleistocene Glacial Stages: Were there More than Four?", a paper which was read before the American Philosophical Society of Philadelphia.

Five glacial stages and four interglacial stages must continue to be included in the classification of the Pleistocene of the Mississippi Valley.

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QUOTATIONS

A WATCH ON DISEASE

THE League of Nations is achieving work of great importance and of abiding utility in the field of international hygiene. The Health Section of the Secretariat, indeed, has already established itself in the regard of every health department in the world and is acknowledged as an indispensable link between nation and nation. This position has been achieved by a policy which reflects credit upon those who originated it. From the beginning the Health Section has recognized that its sphere of action is necessarily limited, even though, paradoxically enough, the limits set upon it are conditioned by the fact that it claims the whole world as its field. It has not sought to interfere in any country or to exercise any kind of superior control. Its object has been to supply all countries with information which no country could easily obtain for itself, and to advise every country of dangers threatening in neighboring or even in far-distant states. A further object has been the study of those conditions which, in all parts of the world, exert an influence upon health or favor the onset of disease. In pursuit of these aims the Health Section has established and perfected a vast intelligence system. In hundreds of areas throughout the world "spies," trained to observe the slightest indications of coming trouble, watch for any "movement" of disease and report to headquarters at frequent intervals. Every day, in consequence, the Health Section is fully informed about the prevalence throughout the world of those immemorial scourges of mankind—plague, cholera, typhus fever, malaria and typhoid fever. It is fully informed also about every outbreak of influenza and about every unusual manifestation of diseases which do not, commonly, assume epidemic form. This information is broadcast as soon as it has been received. To-day the health departments of the world know in advance what dangers they must be prepared to face. They know in which of the ships, approaching their coasts, disease has manifested itself, and in what areas, from which supplies come to them, epidemics are threatening or have already occurred. The medical officers and captains of ships on the high seas are also kept informed about the hygienic condition of the ports to which they are sailing.

It is obvious that this sleepless watch on disease is likely to be the means of preventing many calamities. Epidemics in the past have usually had ample time to develop before a concerted attack was made on them. To-day every health department recognizes that it is its brother's keeper. The tendency to wait until such scourges as cholera and plague have crossed the frontier is giving place to the determination to meet them and defeat them before, in military phrase, they shall have had "time to deploy." This determination has already found expression in the station which the Health Section has established at Singapore. The Far East, as is well known, is an important breeding-ground of disease. A scheme of prevention, of world-wide scope, must necessarily provide means of obtaining and coordinating information in the center of the "enemy's country." It must also have the means of sending help to any area in which help is required. The recent epidemic of dengue in Greece, for example, has been the subject of careful investigation by officers of the Health Section, who have advised the local authorities, have offered them assistance and have in addition kept the health officers of all neighboring countries fully informed about the progress of the malady and about the means of prevention. In a recent issue of the *Epidemiological Report* of the Health Section the situation in Greece is discussed and full information is given about the prevalence throughout the world of plague, cholera and enteric fever. This information supplements the reports which have already been sent out by wireless telephone. The Health Section is engaged at the present time in making surveys of various countries where epidemic diseases are prevalent. It is about to extend its operations to India. The object of these surveys is to gain information about the circumstances which favor the beginnings of disease in different lands, and to arrive at means whereby, when disease manifests itself, a *cordon sanitaire* may be instituted.

But the Health Section is not concerned only with disease. A shrewd judgment has decided that the study of the vital statistics of the world is necessary to a real grasp of the world's health problems. Recent work on the birth-rates and death-rates in Europe illustrates the wisdom of this policy. It has been found, for example, that national frontiers do not delimit areas in which the birth-rate is high or low. Areas in which the birth-rate is high or low extend from one country to another. Thus in Italy the whole of Piedmont and Liguria possesses a birth-rate lower than the average birth-rate of France, whereas the birth-rate in the valley of the Po below Cremona and in the district of the Alpine lakes is high. The population of Southern Italy is very prolific and birth-rates of from 30 to 40 per 1,000 of the population prevail in this area. In France, on the contrary, the highest birth-rates are found in the north, the lowest in the center and in the south. These observations suggest that the type of population is undergoing change in many European countries, since there is a tendency for population to "flow" from a more con-

gested to a less congested area; but against this consideration must be set the fact that, generally speaking, a high birth-rate is accompanied by a high death-rate among infants and young children. By watching closely the ebb and flow of populations throughout the world the Health Section is gaining a new knowledge about the ebb and flow of disease. It is also gaining a new knowledge about those conditions which lead to international friction. "In less than twenty years," says the *Epidemiological Report*, "the pressure of population in the western and center parts of Europe will almost certainly have terminated."—*The London Times.*

SCIENTIFIC BOOKS

The Mosquitoes of the Americas. By HARRISON G. DYAR. The Carnegie Institution of Washington, 1928, Publication 387, 616 pp. of which 123 are printed as plates of illustrations.

THE taxonomic volumes of the four-volume monograph of "The Mosquitoes of North and Central America and the West Indies" were published by the Carnegie Institution of Washington in 1915 and 1917. In the eleven years since Volume IV appeared there has been great activity in work relating to mosquitoes, and large numbers of new forms have been described. The great bulk of this descriptive work has related to forms from other parts of the world. The U. S. National Museum has remained the center of the American work, and Dr. Dyar, of the museum, has written the present volume. He has found it possible to include South American forms; hence the title, "The Mosquitoes of the Americas."

The material additional to that studied in 1917 has been gained largely in North America, Panama and the north coast of South America. Some additional collecting has been done in the West Indies and in continental South America south of the Guianas. Dr. Dyar himself, during these years, has personally collected through Canada and the northwestern United States, making great additions. Workers in Panama have also contributed largely. Dr. Dyar states that now the great need is for original unworked collections from tropical America. It is hoped that the publication of this volume will encourage South Americans to take up this work.

It may seem strange that, in spite of the greatly increased geographic range of the present volume, the number of species included is but little greater than that described in the former work. This, of course, indicates the need for intensive studies all through the American tropics, and it should be pointed out that another reason for the unexpected smallness of the list is that Dr. Dyar found it necessary to make wholesale reductions in the specific names, especially in Culex and Wyeomyia. The volume includes 544 species, as against 380 in the former monograph. Dr. Dyar informs me that he has now in press a paper describing two additional species.

Although many specific names have been relegated to the synonymy, the genera remain comparatively unchanged. The author has included many subgenera based upon the structure of the male genitalia and has given these subgenera careful study from the point of view of relationship.

In the former volume only two tribes of the Culicinae were recognized. The present volume recognizes five tribes: namely, Anophelini, Uranotaeniini, Sabethini, Megarhinini and Culicini.

With regard to one of these tribes, the Sabethini, a curious situation arises. In the American fauna this group is well marked, but Edwards, of the British Museum of Natural History, contends that, taking the mosquitoes of the whole world into consideration, there does not exist at present a known character by which the Sabethini as a tribe can be recognized. Dr. Dyar really founds his tribe on a peculiar larval character which holds for the Americas, and thinks that it may yet be found reflected in some adult structure. That this character (the absence of a median ventral brush on the anal segment) is not due (as with many other larval structures) to some peculiar method of life in the larval stage, is shown by the fact that species of other groups having the same larval habitat, namely the confined spaces between leaves and bracts holding water, have not acquired even a trace of a similar characteristic.

It will be remembered that the authors of the earlier monograph introduced the rather radical novelty of separate synoptic tables for the male genitalia and for the larvae. In fact, Dyar's interest in mosquitoes was an outgrowth of his early efforts towards a larval classification. This idea, followed in the careful tables in the present volume, has really brought about the stability of the present classification of mosquitoes. Edwards, of the British Museum, through his own independent studies of a very different fauna, has come to practically the same conclusions. His sole divergent view now rests upon his non-acceptance of the Sabethini as a tribe. The harmony between London and Washington in regard to mosquitoes is now so complete that dreams of the past seem nightmares!

The same format and practically the same type and paper are used as in the four-volume monograph, and in fact this volume should really be considered as a

supplement to and a revision of the taxonomic portions of the former monograph.

It contains no plates so beautiful as those of the full-grown larvae, done by Frederick Knab, in the old monograph, but there are 123 plates showing the male hypopigium of different species and larval heads and larval anal segments and appendages. There must be seven or eight hundred independent drawings in all. Half of these are new and were made by Miss Eleanor T. Armstrong and Miss Mary C. Foley under Dr. Dyar's direction.

The volume is a very handsome one, and is bound to be of great use. The entomologists and sanitarians of all the Americas are very fortunate in that Dr. Dyar has been able to do this great work at this time. And all of us, including Dr. Dyar, have been fortunate in that the trustees of the Carnegie Institution of Washington have permitted its publication in such excellent shape. The warm interest of President John C. Merriam is doubtless largely responsible.

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REPORTS

THE NEW ENGLAND INTERCOLLEGIATE GEOLOGICAL EXCURSION

THE twenty-fourth annual New England Intercollegiate Geological Excursion was held in the vicinity of Boston, Massachusetts, October 12 and 13, under the leadership of Dr. Kirtley F. Mather. On Friday morning the excursionists studied the glacial geology south of Boston, devoting most of their time to the region about Scituate. Extensive workings by the Boston Sand and Gravel Company have exposed instructive sections, especially in the vicinity of the Greenbush Station. Here an older interpretation would place a recessional moraine, south from which an outwash plain was deposited. A more recent interpretation would postulate a lake lying southward from a stagnant ice-sheet and dammed by the ice to the north and east and by the hills to the south and west. The merits of these two hypotheses were debated in the field.

At the invitation of the Boston Sand and Gravel Company lunch was served at their club house near the Greenbush Station.

Friday afternoon the group was under the leadership of Dr. R. W. Sayles and Dr. Marland Billings. After a beautiful drive along the shore through the towns of Scituate, Cohasset, Hingham, Weymouth and Quincy, we came to Squantum. Here Dr. Sayles has studied the Squantum tillite for a number of years. His studies have recently become very important because of their relation to the Wegener hypothesis of floating continents.

Dr. Wegener has drawn a map of the world during the Permian period, rearranging the continents in such a way that the equator of that period would pass through New England. Supporters of his hypothesis have doubted the existence of glaciation at Squantum because it interfered with this hypothesis. The New England geologists were very glad of the opportunity to study this locality under the guidance of Dr. Sayles.

The evidence of glaciation shown by Dr. Sayles were (1) the tillite with characteristic lack of sorting and with occasional striated pebbles; (2) varved clays which have been studied under the microscope and have been demonstrated to be similar to the clays of Pleistocene lakes; (3) gliding planes within the clays which have mashed the clay layers and which were started, perhaps, by floating ice; (4) inclusions of blocks of the varved clays in the overlying sediments, indicating that they were solid enough to be broken up and moved by contemporaneous agents of erosion. Most of the geologists agreed that the evidence was very conclusive. There was a question whether the glaciation was local or regional.

After a strenuous day in the field the dinner at the Commander Hotel, Cambridge, was much appreciated. During the evening there was a conference at the Harvard Geological Museum. Greetings were sent Dr. William North Rice, who attended the first excursion in 1901 at Westfield, Mass., and has been present at most of the gatherings since that time. It was decided to hold the twenty-fifth excursion in the vicinity of Littleton, New Hampshire. Dr. Keith, of the United States Geological Survey, and Dr. Kirk Bryan, of Harvard University, gave a history of the geologic study of the Boston Basin and Dr. Marland Billings explained a recent map of the structure of the basin.

On Saturday morning there were busses awaiting us at the Agassiz Museum and the day was spent in the vicinity of Boston under the guidance of Drs. Bryan and Billings. Details necessary for the construction of a cross-section between Jamaica Plains and the Blue Hills, south of Boston, were studied. Dr. Billings believes that the key to the geologic structure of the Boston Basin lies in the presence of overthrust faults which have brought the basal complex of the Dedham granodiorite and its associated Mattapan volcanics into contact with the Cambridge slate, the uppermost member of the Boston Basin series.

The Boston Basin series consists of the basal Dedham group and Mattapan complex overlain by the Roxbury conglomerate, the Squantum tillite and the

Cambridge argillite in the order named. Hitherto certain argillites interbedded with the Roxbury conglomerate have been confused with the Cambridge argillite. The structures have been simplified by the discovery of this error.

The thrust planes within the basin are abnormal since they have been tilted from a low angle at the time of their initial development into vertical or overturned positions at the present time. Doctor Billings' sections were sometimes difficult to understand since the field evidence would force his thrusts to originate in a direction *away from* that toward which the planes now dip—the thrusts coming from the south and the thrust planes now dipping steeply to the north.

Twenty-eight colleges and institutions were represented during the excursion.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

ISOPROPYL ALCOHOL AS A PRESERVATIVE

WHILE working at Reed College in 1922 I put up several specimens of the western newt, *Triturus torosus*, in isopropyl alcohol in order to test the usefulness of this alcohol as a preserving fluid. This was done at the suggestion of Dr. L. E. Griffin, who was experimenting with substitutes for ethyl alcohol. Six newts were preserved; one each in 40 per cent., 50 per cent., 60 per cent., 70 per cent. and 80 per cent. of Petrohol (the trade name of the isopropyl alcohol used) with a control in 70 per cent. grain alcohol. As the Petrohol contained only 91 per cent. of isopropyl alcohol the actual concentrations ranged from 36.4 per cent. to 72.8 per cent. The newts varied from 134 to 178 mm in length and from 14 to 19 mm in greatest diameter of body. They were chloroformed and the abdomen pierced with a stout pin before putting them in the preserving fluid.

I looked for these specimens last spring but could not find the control. As they were dated March 31, 1922, they had stood for six years, a very fair test for the fluid.

The discoloration of the liquid was quite noticeable, for it grew progressively darker as the concentration decreased. The 80 per cent. was almost clear, while the 40 per cent. was a greenish amber, though no darker than ethyl alcohol sometimes gets by standing on specimens. As the skins of the newts were faded proportionately, it seems clear that isopropyl alcohol dissolves the dermal pigment more readily in low than in high concentrations.

The specimen in 40 per cent. Petrohol was faded to a dull grayish brown above and dirty yellowish white below, the original reddish brown and orange yellow having completely disappeared. The 80 per cent. specimen had the colors very well preserved for an alcoholic and the others varied between the two extremes.

The bodies of those in 40 per cent., 50 per cent. and 60 per cent. were soft and pliable (except that the last was rather stiff) and the jaws could be opened easily. The 70 per cent. and 80 per cent. specimens on the other hand were stiff and badly shrunken and the jaws were very hard to open. The muscles of the first three were in good condition for dissection. The skin peeled readily from the muscles and the latter were easily parted from the bones. Apparently it would be easy to make a skeleton from any of the specimens. The cartilage was yellow like the muscles, otherwise it appeared about as in life.

The viscera of all were perfectly preserved with no sign of decay anywhere. The liver was soft but not mushy except in the 70 per cent. and 80 per cent. specimens, where it was harder and adherent to the body wall.

The heart, blood vessels and contained blood were faded to a yellowish color. Heart muscles were in good condition except that in the 60 per cent. specimen they were rather brittle. This fading of the blood made it rather hard to trace veins and arteries except in the liver.

Perfect preservation in such low concentration of any alcohol is unusual and may prove to be a valuable property of isopropyl alcohol. The fading effect seems to be confined to the blood and heart muscles and to the yellow pigment of the skin, as the 40 per cent. specimen was only a little paler dorsally than the 80 per cent., though much less yellow. Perhaps this would not be the disadvantage in other groups that it is in the Amphibia. The ones in 40 per cent. and 50 per cent. were softer and in better shape for examination or dissection than most alcoholics are. For many anatomical specimens I believe that isopropyl alcohol would be an excellent preservative.

Griffin[1] has shown that isopropyl alcohol is useful for histology, that it may be used freely without the annoying restrictions placed on the use of grain alcohol and that it can compete with the latter in price. The fact that it can be used in low concentrations should make it an economical preserving fluid. It lacks the irritating properties of formalin and does not soften the bones or teeth in the same way.

[1] L. E. Griffin, "Practicable Substitutes for Grain Alcohol," SCIENCE, 55: 262, 1922.

This experiment is a very incomplete one and I should be glad to see further work (which I can not do myself at present) done on the uses of this interesting fluid.

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A NEW PROCESS FOR HANDLING SOUTH AFRICAN PLATINUM ORES

The *South African Mining and Engineering Journal* for September 8 and 15 gives a detailed description of a new process of platinum recovery from the sulfide-norite ores of the Transvaal, which has been originated in the Ferreira laboratory of the Rand Mines metallurgical department. As the process is along new lines, a brief outline is of general interest.

The ores, after crushing and ball-mill grinding, are reduced by flotation to a 5 per cent. concentrate. These concentrates contain, in addition to the platinum metals, copper and nickel sulfides and a small amount of gold. They are first roasted to a negligible amount of sulfur, then mixed with salt and heated with chlorine in a muffle. The temperature used is about 540° C., at which heat the platinum metals, as well as the copper and the nickel, are completely changed into soluble chlorides, while the temperature is too high for the chlorination of the gold. The current of chlorine is so controlled that practically all is absorbed, the amount used being 100 to 120 pounds per ton of concentrates. The platinum metals are changed into the very soluble sodium chloro-salts.

The chlorinated mass is leached with slightly acid water and the copper precipitated as the carbonate by finely ground limestone. This precipitate runs about 20 per cent. copper and can be smelted direct to blister copper. The small amount of platinum and iridium precipitated with the copper is recovered as anode sludge when the copper is electrolytically refined. After filtering from the copper precipitate, the platinum metals are precipitated by zinc dust, and after refiltering the solution is run through a zinc extractor for complete recovery of the platinum metals. The nickel present is then thrown down with bleaching powder. The chlorinated ore, after leaching, is treated by cyanidation for gold.

The novelty of the process consists in the chlorination of the platinum metals and the precipitation of the copper by limestone. The process has already passed beyond the laboratory stage, and works satisfactorily on semi-plant scale. It promises to be a solution of the difficult problem of handling the South African platinum ores.

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SPECIAL ARTICLES

SCATTERING OF QUANTA WITH DIMINUTION OF FREQUENCY

The purpose of this note is to point out the correlation of several recent experiments on scattering of quanta with one another and with a very general principle which was foreshadowed some years ago, and has since then become more plausible through the demonstration that quanta and electrons alike possess some of the qualities of waves.

The notable experiments of Raman, verified and extended by several other physicists,[1] have shown that a quantum of sufficient frequency impinging upon a molecule may employ some of its energy in exciting the molecule, and continue on its way with the remainder, rebounding from the impact in the form of a quantum of diminished energy and augmented wave-length. The analogy with the electron is very close, for an electron may use part of its energy in exciting an atom, and rebound from the encounter in the form of an electron of diminished energy and augmented wave-length. In addition, various experimenters[2] have shown that a quantum impinging on a crystal may spend part of its energy in exciting vibrations of the sort which are responsible for Reststrahlen, and which are attributed to inter-atomic forces of the lattice; and having done this, the quantum may emerge with the balance of its energy and a correspondingly modified wave-length.

In the Compton effect—to use this term in its restricted sense—a quantum confers upon a free or nearly free electron a fraction of its energy, and goes onward with the remaining fraction, its wave-length being altered accordingly. In a sense, this case is at the opposite extreme from that which Raman observed, for the transferred energy goes into a non-quantized form. Cases intermediate between these two extremes are disclosed by two recent series of experiments. In those of Davis and Mitchell,[3] the scattered X-rays emerging from carbon (in the form of graphite) irradiated by the $K\alpha_1$ rays of molybdenum were found to comprise quanta which are evidently incident quanta which have given up an amount of energy just sufficient to extract an electron from the K-level of a carbon atom. The wave-length of these agrees within 4 per cent., as the authors point out, with the value predicted from this interpretation. There are two other sets of scattered quanta

[1] C. V. Raman and K. S. Krishnan, *Indian Jl. of Phys.*, March 31 and July 31 (1928); *Nature* (1928) *passim;* P. Pringsheim, *Naturwiss.*, August 3 (1928); R. W. Wood, *Nature*, Sept. 8 (1928).

[2] C. V. Raman, *ibid.;* G. Landsberg, L. Mandelstam, *Naturwiss.*, July 13 (1928).

[3] B. Davis and D. P. Mitchell, *Phys. Rev.*, 31: 1119; 32: 331–335 (1928).

which have lost amounts of energy agreeing in order of magnitude with the amounts required to extract superficial electrons from carbon atoms; and while Davis and Mitchell state that the agreement is not exact, the extraction-potentials of these superficial electrons are still so uncertainly known and so much influenced by the environment of the atom that we need not yet concede that there is a contradiction. Indeed, it might be contended that the displacements of these two sets of quanta from their initial frequency are the best extant measures of the extraction-potentials of the outer electrons of carbon atoms in the graphite lattice. In these experiments, then, quanta confer upon atoms sufficient energy to remove individual bound electrons, and are scattered with the energy they have left over. Other such cases are revealed by the great quantity of data obtained during the years 1923–24 by G. L. Clark, W. Duane and their collaborators,[4] bearing upon what they called the "tertiary radiation" of substances irradiated by X-rays. I am indebted to my colleague, Dr. C. H. Prescott, for an allusion to these in the course of a conversation about the "Raman effect."

This tertiary radiation is precisely analogous to the scattered quanta with diminished frequency observed in the X-ray region by Davis and Mitchell, and in the optical region by Raman. To show this it is sufficient to quote the theory originally propounded by Clark and Duane, which was found adequate to account for the *frequencies* though not for the *intensities* of the tertiary rays. They assumed that the primary quanta extract electrons (usually K electrons, in the conditions of their experiments) from the atoms on which they impinge, and that these electrons are suddenly retarded or arrested by impacts on other atoms, conferring their kinetic energy on newborn quanta by the same process as is supposed to occur when continuous-spectrum X-rays are generated by the impact of cathode-rays on the target of an X-ray tube. The quanta so created should have frequencies ranging upward from an unspecified minimum to a maximum equal to that of the primary quanta *minus* the K-excitation-frequency of the scattering atoms. Bands with short-wave-limits at the stated frequency were actually found in the spectra of X-rays scattered by silver, molybdenum, germanium and several other elements. Now exactly the same phenomena are to be foreseen if the "tertiary" quanta are primary quanta which have spent some of their energy in extracting K electrons from atoms and in endowing these with various quantities of extra kinetic energy. This theory, which was proposed by A. H. Compton,[5] does not seem to be endangered by the absolute intensities and the distribution-in-intensity of the observed bands, which according to D. L. Webster[6] were incompatible with the theory of Clark and Duane. The absolute intensities are measures of the abundance of quantum-impacts of this type; the distribution-in-intensity of any band depends upon the relative probabilities of the transfer of different amounts of kinetic energy to the liberated electrons.

We have thus at least four and perhaps five distinguishable cases of quanta surrendering part but not the whole of their energy: (1) in excitation of molecules (Raman); (2) in excitation of vibrations in crystal lattices (Raman, Landsberg and Mandelstam); (3) in collisions with free electrons (Compton); (4a) in ionization of atoms by removal of inner electrons, attended in general by transfer of additional energy to the liberated electrons (Duane and Clark); (4b) in ionization of atoms by removal of inner and outer electrons, not attended by additional transfer of energy to the liberated electrons (Davis and Mitchell). Probably, then, it is a valid general principle that a quantum can divide its energy, giving up a part and retaining the remainder; and this can happen whenever there is an encounter between a quantum and an electron, atom or system of atoms capable of receiving energy in quantities smaller than the quantum initially possesses. This principle was adumbrated by A. Smekal[7] before any of the experiments which I have cited. One wonders why it did not earlier win favor; but very likely the reason is that until very recently it has not been easy to conceive that a quantum may change its frequency and yet, in a profound sense, remain the same quantum. One felt instinctively that if a quantum of one frequency entered an atom or a piece of matter and a quantum of another frequency emerged, the former must first have disappeared, the latter have been subsequently born through some intermediate process. Now that it is clear that electrons also possess the properties of wave-motion, the difficulty becomes universal, and consequently acceptable. When an electron is speeded up or slowed down, its wave-length changes; if we conceive that nevertheless it remains the same electron, can we do otherwise than suppose that a quantum retains its identity when its wave-length is altered?

Of course it must not be supposed that whenever a quantum of one frequency strikes an atom and a quantum of another frequency comes off, there has been a scattering-process of the foregoing type. Certainly there are cases in which an atom absorbs a

[4] *Proc. Nat. Acad. Sci.*, 9 (1923) and 10 (1924).
[5] *Phys. Rev.* (2), 24: 168–177 (1924).
[6] *Proc. Nat. Acad. Sci.*, 10: 186–191 (1924).
[7] *Naturwiss.*, 11: 873–875 (1923).

quantum and after an appreciable interval of time emits another, for it is known that a "collision of the second kind" may involve the atom before the interval is ended, and alter the character of the emitted quantum. This might be made the basis for the distinction between fluorescence and scattering.

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THE USE OF INTERNAL PRESSURE IN METALLIC SYSTEMS

System Lead-Antimony Copper

Until recently the application of thermodynamic relationships to metallic systems has been almost wholly neglected. J. Johnston,[1] using a method similar to that proposed by Washburn[2] and Read, has shown that the eutectic composition and temperature can be calculated from the solubility curves, and conversely, knowing the eutectic temperature, the solubility can be calculated. In this work, ideal solutions are postulated, but many metallic solutions must closely approach this condition, so that the method should be valuable as a first approximation.

There are three properties of metals which are useful in predicting the miscibility of the liquid phase or even hazarding a guess as to the solid solubility. The most important of these is the internal pressure which is defined by Dupre,[3] as equal to $(-T\frac{\alpha}{\beta})$, where "T" is the absolute temperature, α the coefficient of expansion, and β the coefficient of compression. Liquids with like internal pressures should be more easily miscible than those with unlike. That this assumption is at least followed in substance is demonstrated by Hildebrand[4] with a correlation of existing data on the subject. He shows that those metals which form continuous series of solid solutions have very similar internal pressures, and that those metals which display a miscibility gap are separated in the table by a definite amount. The other two useful properties of the metal are the melting-points and heats of fusion.

The formation of compounds may have a greater effect than the properties named above. The extent of the effect of the compound formation depends on the stability of the compound. When it is stable in the liquid phase, it must be considered a new component with its own internal pressure, melting-point and heat of fusion. On the other hand, compounds which dissociate completely at or before their melting-point have little effect on the miscibility of the liquid phase, since the liquid phase is then composed of only the two original metallic atoms. However, the compound may have a decided bearing on what solid will separate under a given set of conditions. In addition to the melting-points and heats of fusion, the heat of formation of the compound must be taken into consideration. The shape of the liquidus and solidus surfaces depends on these principles. With the help of certain judiciously chosen freezing curves, the surfaces may be accurately known.

Application to the Copper-Lead Antimony System

In studying the ternary system of lead-antimony copper,[5] there is a good chance to demonstrate the effect of internal pressure in shaping the liquidus surface. In building this surface it is important to have the component binary liquidus lines in mind. In the system lead-antimony[6] no compounds are formed, and there is a solid solubility of antimony in lead as well as a reported solid solubility of lead in antimony.[7] The eutectic occurs at 12.5 per cent. antimony. From Table I it is seen that the internal pressures of lead and antimony are close together. The value for bismuth is shown in the table because it is the only metal other than antimony in the fifth group of the Periodic Table for which any values could be found. General trends in the Periodic Table indicate that internal pressure decreases in going from top to bottom in any group, which places the value for antimony in the vicinity of that for lead. From this consideration,

TABLE I

Relative Internal Pressures

Metal	From expansion and compression of solid metals*	Heat of vaporization*	Surface tension*	Boiling points	Viscosity at 1100° C.†
	α/β	L/V	$\gamma/v^{\frac{2}{3}}$	°C.	η
Cu	67	8850	581	2310	0.036
Ag	56	5500	782	1955	——
Pb	38	2410	444	1525	0.0105
Sb			317	1440	0.0082
Bi	12.5	2030	376	950	0.0065

* Hildebrand, *loc. cit.*, pp. 181–182.

† Bieneas and Sauerwald, *Z. anorg. Chem.*, 161: 51, 1927.

[1] J. Johnston, *J. Phys. Chem.*, 29: 882, 1925.

[2] Washburn and Read, *Proc. Nat. Acad. Sci.*, 1: 191, 1915.

[3] Dupre, *Ann. chim. Phys.*, 2: 201, 1864.

[4] Joel Hildebrand, "Solubility," Am. Chem. Soc. Monograph, p. 102, 1924.

[5] R. A. Morgen, L. G. Swenson and F. C. Nix, Tech. Pub. 43, Am. Inst. Mining and Met. Eng., 1928.

[6] R. S. Dean, *J. Am. Chem. Soc.*, 45: 1683, 1923.

[7] Endo, Sci. Repts., Tohoku Imp. Univ. 14: 503, 1925.

complications in the liquid phase of the lead-antimony system are not to be expected. The internal pressures of copper and lead on the other hand are widely separated, and the effect of this wide difference is shown in the binary system.[8] There are no compounds formed so a miscibility gap appears. Between 15 per cent. and 65 per cent. copper by weight, there are two liquid phases. An eutectic between copper and lead appears at about 0.05 per cent. copper. Copper and antimony are just as widely separated in internal pressure values as copper and lead. However, the fact that a compound,[9] Cu_5Sb_2, forms, which is stable at its melting-point, changes the consideration. Two other compounds, Cu_3Sb and Cu_2Sb, are known in this system, but they are unstable at their melting-points and are formed by the decomposition of Cu_5Sb_2 on cooling. For this purpose, therefore, we shall consider the copper antimony system as divided into two parts, namely, copper-Cu_5Sb_2 and Cu_5Sb_2-antimony. The fact that solid solubility occurs at both ends of the system and that both copper and antimony dissolve in the Cu_5Sb_2 crystals indicates that the internal pressure of Cu_5Sb_2 is between that of antimony and copper.

With this information, it is now possible to see how the shape of the immiscibility gap in the ternary system copper-lead antimony checks with the theory. Since there is a break on the copper-lead side and none on the copper-antimony line, the curve of immiscibility must close on itself. Fig. 1 is a representation of

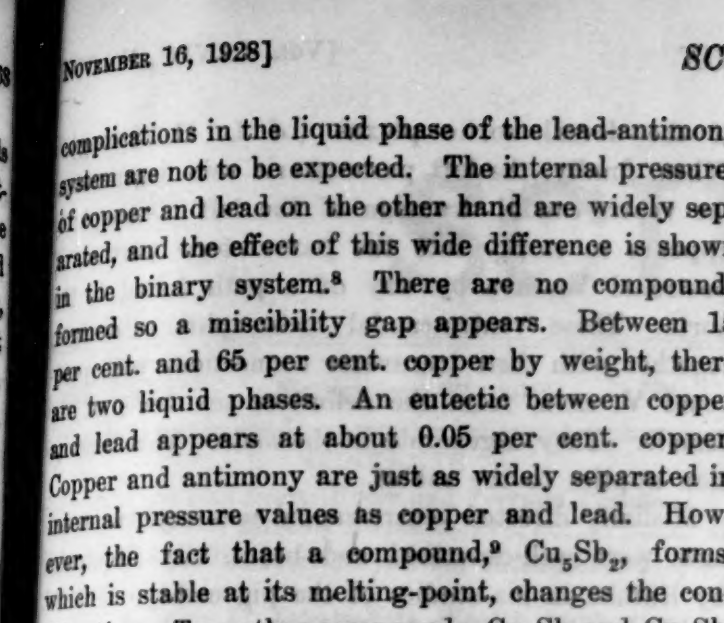

FIG. 1

the system reproduced from the paper of Morgen,[10] Swenson and Nix. The two liquid layer region found experimentally is bounded by the line DFTGL. Starting at D the boundary drops sharply towards F, which corresponds to about 2.5 per cent. antimony by weight. This is the amount of antimony which has solid solubility in lead, so that up to this amount in the liquid state, the antimony just acts to replace so much lead, probably approaching a perfect solution. The following generalization then seems to follow: Over the range where a solid solution separates, the liquid behaves like the pure solvent or approaches a perfect solution of the two constituents. From F to K the line is practically horizontal. This is the region in which lead is the primary crystal and so further addition of antimony, over 2.5 per cent., makes little difference in the ternary liquid mixture. K probably corresponds to the point at which lead and antimony are in the proportions in which they exist in the eutectic. From K to T the line starts to curve, but since in this region an antimony compound, Cu_2Sb, is the primary crystal, the effect of the low internal pressure of antimony is still noticeable, tending to extend the area of immiscibility. After the line PT is passed, the primary crystal is Cu_5Sb_2, and so this compound is the dominating factor, and the curve turns away from the antimony corner. The point G, the nearest approach to the copper-antimony line, is at 5 per cent. antimony. This corresponds to the solid solubility of lead in antimony and agrees with the generalization made previously. From G the curve returns sharply to the copper-lead axis. In this region the three substances to be considered are copper, Cu_5Sb_2, and the copper-lead mixture indicated by L. These three have effective internal pressures close enough together so that they are completely miscible in the liquid phase.

[8] F. Friedrich, *Met. u. Erz.*, 10: 578, 1913.

[9] H. Reimann, *Z. Metallkunde*, 12: 321, 1921.

[10] *Loc. cit.*

CONCLUSIONS

A method has been suggested whereby the shape of miscibility gaps may be predicted.

A relation is pointed out between solid solution formation and an effect on the liquidus surface.

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DIMORPHISM IN THE DEVELOPMENTAL HISTORY OF THE SEX VEINS OF THE RABBIT

THE right sex vein of the adult male rabbit is described by Krause (1884)[1] as entering the vena cava inferior at the level of the fifth lumbar vertebra. The left sex vein of the adult male rabbit is described in the same account as entering the left renal vein. According to Krause, both sex veins of the adult female rabbit directly enter vena cava inferior

[1] Krause, W., "Topographische Anatomie des Kaninchens," II Aufl., Leipzig, 1884.

at the segmental level at which the right sex vein enters the V. cava inferior in the male rabbit.

According to Hochstetter (1902)[2] the right sex vein of the rabbit is a derivative of the cranial portion of the original ventro-lateral posterior cardinal element of the venous ring about the ureter. He states that the left sex vein of the rabbit contains two elements: one of these corresponds bilaterally to the right sex vein; the other element corresponds bilaterally to that portion of postrenal V. cava between the right renal vein and the point of entry of the right sex vein into V. cava. His diagrams give the impression that in rabbits of either sex the sex veins are entirely of posterior cardinal origin; that the developmental procedure is the same in the two sexes.

Our recent studies have convinced us that the sex veins of the adult female rabbit enter the V. cava inferior not at the level of the fifth lumbar vertebra but at the level of at least one segment caudal to this. They enter symmetrically or very nearly so.

The sex veins of the adult male rabbit have the relationships to V. cava described by Krause for the male rabbit. They have a development (in the male) similar to that shown in Hochstetter's schemata for rabbits of either sex. The development of the female sex veins has never been correctly described for the rabbit or for any other placental mammal.

The counterparts of male sex veins are well developed in the female. So far as they are in relation to the mesonephros, they lie dorsal to the mesonephric arteries. They never acquire (in the female) connection with the longitudinal vein which directly drains the gonad. Intra-mesonephric segments of posterior cardinal veins (portions of true sex veins of the male rabbit foetus) normally acquire such connections.

In the female rabbit embryo, and to a slightly lesser degree in the male, there develops on the ventro-medial surface of the caudal pole of each mesonephros a strong transverse venous drainage. On each side it enters directly the medial cardinal vein (possibly the "cardinal collateral" of Huntington and McClure). At this same level on each side there is established a transverse anastomosis between medial cardinal vein and paraureteric vein (lumbar "supracardinal" of Huntington and McClure). Adjacent to this level, cranially and caudally, the medial cardinal veins degenerate or become very slender. Thus each ventro-caudal mesonephric drainage appears to enter directly the corresponding paraureteric vein. The condition is only secondarily established. At this same level an anastomosis forms transversely between the paraureteric veins. This anastomosis is a product of the dorsal aortic plexus (of L. H. Strong).[3] When, finally, the left paraureteric vein degenerates, the ventro-caudal drainage of the left mesonephros appears to empty into the paraureteric portion of postrenal V. cava by way of a path dorsal to the aorta. These ventro-caudal mesonephric drainages, together with their transverse connections with postrenal V. cava, form the definitive sex veins of the female. They degenerate in the male. This description applies to the rabbit.

Medially directed ventro-caudal mesonephric drainages were well-described and beautifully illustrated by Rathke in his studies of the pig embryo in 1832. This work is reviewed by F. P. Reagan, in an article now in press. Rathke[4] evidently interpreted the immediately pre-iliac position of these vessels as indicating that the sex veins of ungulates are generally in this position. Vessels comparable to those seen by Rathke were observed in pig embryos by Butler (1927).[5] From the latter account one gets the impression that these are the definitive sex veins of pigs of either sex. In some ugulates, at least, it is certain that the male sex veins are not derivatives of this ventro-caudal mesonephric drainage. In the pig, Butler calls these veins "mesial caudal tributaries" to the "supracardinals" of his terminology. It is not clear whether these are comparable to the "postcardinal mesial-caudal tributaries" of McClure and Butler (1925).[6]

The strikingly great difference in degree of posterior cardinal persistence in adult male and in adult female rabbits is not reflected in a comparatively great difference in degree of mesonephric activity in their male and in their female embryos.

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[3] Strong, L. H., "The Dorsal Aortic Plexus, a Factor in the Dorsal Body Wall Drainage of the Rabbit," *Univ. of California Publ. in Zool.*, 9, 305, 1927.

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[5] Butler, E. G., "The Relative Rôle Played by the Embryonic Veins in the Development of the Mammalian Vena Cava Posterior," *Am. Jour. Anat.*, 39: 267, 1927.

[6] McClure, C. F. W., and Butler, E. G., "The Development of the Vena Cava Inferior in Man," *Am. Jour. Anat.*, 35: 331, 1925.